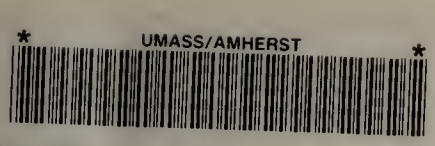
MASS. EA20.2:P93



312066 0270 8279 0

PRIVATE WELL WATER QUALITY DATA BANK FEASIBILITY ANALYSIS FOR MASSACHUSETTS

Stephen Plotkin
Agricultural and Resource Economics
University of Massachusetts, Amherst

Dr. Carolyn R. Harper
Agricultural and Resource Economics
University of Massachusetts, Amherst

Dr. Cleve E. Willis
Agricultural and Resource Economics
University of Massachusetts, Amherst

Gisela Walker
Cooperative Extension
University of Massachusetts, Amherst

COLLECTION
APR 1 8 1990
Depository Copy

June 1989

Final Report of the University of Massachusetts Private Well Water Quality Data Bank Feasibility Study in furtherance of a contract with the Massachusetts Department of Environmental Quality Engineering (DEQE).

Additional copies of this report may be purchased from the Environmental Institute, Blaisdell House, University of Massachusetts, Amherst, MA 01003.

K.N.

Disclaimer

This DEQE contracted research does not necessarily represent the positions or policy of the Department and the Department does not endorse or recommend any proprietary product or material mentioned herein.

ABSTRACT

Private well water testing in Massachusetts is generally performed by commercial environmental laboratories. Consequently, test results are for the most part unavailable to the public or to regulatory agencies. This study assesses the feasibility of creating a central data bank system for private well water quality data. All 55 certified commercial laboratories were contacted, and 52 participated in a survey to determine methods and costs which might be required to build a data bank. It was determined that thirty-six labs currently perform private well water analyses. Twenty of these keep computerized records; the remainder keep records on conventional data sheets. Computerization of labs has been proceeding rapidly for the past several years. Most labs were potentially willing to contribute information on a regular basis to a central data bank. Client confidentiality with respect to well location was found to be the only major concern of most labs. This problem is circumvented in other states contacted through the use of state-run testing labs, where all data are considered public information. Alternatively, in states such as Massachusetts and New York where testing is performed by commercial labs, owner-signed release forms could be used to make available more complete information about well location and well characteristics. Direct costs associated with constructing and maintaining a private well water quality data base, in cooperation with certified laboratories, are estimated to be relatively modest.

EXECUTIVE SUMMARY

Approximately 400,000 people in the Commonwealth rely on private well water supplies. Private wells are the sole sources of water for households in 61 municipalities. There is little public information concerning water quality or levels of contamination for most of these sources. However, analyses for many private wells have been performed by the 55 certified commercial environmental laboratories in the state. The present study was undertaken to determine the feasibility of collecting information from commercial laboratories to create a central data bank for private well water quality information.

Four labs were selected for preliminary interviews, which aided in designin an appropriate survey questionnaire to be sent to all 55 labs. The survey consisted of 18 multiple choice questions organized into the following four sections: 1) number of private well tests performed, lab certification for tests performed, and available data on well physical characteristics, 2) manner in which data are stored, 3) willingness to contribute existing data confidentiality concerns, and employee time required to provide data, 4) willingness to contribute future generated data, willingness to use owner-signed release forms, and compensation requested by the labs.

A 100% rate of contact and a 95% survey response rate were achieved from mai returns and telephone follow-ups. Fifty-two labs answered survey questions; three chose not to participate. Thirty-six labs indicated that they perform private well water tests. During the one year period March 1, 1988, to February 28, 1989, these labs estimated that they had tested water samples from 22,808 private wells. Twenty of the 36 labs keep data records in computerized form; these records account for 13,150 or 58% of the private wel. water analyses. The adoption of computerized data base systems by the labs has been quite rapid in the past several years.

Each of the twenty computerized labs use different data base software systems to store their data. However, most systems allow data conversion to ASCII, the universal text format; such conversion would allow relatively easy transfer of data to a central data bank. Most of the 36 labs with private well data were amenable to contributing existing data to a central data bank, provided well locations were identified by town only to protect owner confidentiality. Thirty-one of 36 labs said they would be willing or might be willing to ask well owners to sign release forms, so that complete well addresses and perhaps other well characteristics could be contributed to a central data base in the future, along with water quality data.

Interviews with potential users indicated that there is widespread demand for private well water quality information. There is concern that so little is known about this major source of drinking water. The data bank would provide government agencies, academic researchers, and the public with information that could potentially contribute to protection of public health. The data would also help to identify areas where pollution proximity and infiltration studies might be appropriate.

Several states with established or emerging private well data bases--New Hampshire, New York, Rhode Island and Wisconsin--were contacted to learn what methods are used to collect information. Three of these states, all except New York, support state laboratories as well as field personnel for sampling or mapping. Well data are treated as public information. New York is in an early state of establishing a data base similar to the one investigated here. The system will rely on data obtained from commercial labs; and owner release forms will be used to satisfy confidentiality concerns. The data will be regularly collected on computer disks or data sheets, and sent to a central data bank.

It is estimated that existing data for the past three years could be acquired from Massachusetts commercial labs with primary direct costs totalling about $17,000 to $38,000. These figures include programmer time, data entry, and lab employee compensation for 20,000 to 50,000 private well water analyses. For existing data, well locations would have to be identified by town only, because of confidentiality concerns of the commercial labs. These costs would be one-time expenditures. However they do not include administrative costs, the extent of which would depend on how and where the project was carried out.

For water quality tests which will be performed in the future, it is assumed that laboratories would adopt a standard release form, so that data could include exact well location along with test results. Major direct costs to establish this type of data base, which would receive data from commercial laboratories on an ongoing basis, are estimated to be about $15,000. For computerized data, the costs of periodic updating would be negligible, in terms of both laboratory transfer time and data bank programming. The sole major direct cost for updating would be an estimated $2,000 annually for manual entry of incoming noncomputerized data. This cost is optional, because the data bank could rely exclusively on data from computerized labs.

The release form to be developed by DEQE should have two components. The first is a request for owner permission to include the information in a data bank whose purpose is protection of public health. The second is an inquiry whether the testing is to comply with any state law or local Board of Health regulation. If so, test results are public information. A positive response to either part would allow test results to be included in the data bank with full information about well location.

Most Boards of Health require water quality testing for new wells; these samples are often submitted to labs by well drillers rather than owners. Tests required by Boards of Health could in principle be obtained directly from town agencies, but this would be cumbersome and expensive. It would be necessary to cooperate with 275 local Boards, the total number of Massachusetts towns in which there are private wells. Since virtually all testing is performed by certified commercial labs in any case, it is far more efficient to obtain data directly from the 36 labs which test private well water. Most labs would adopt the standard waiver form voluntarily. To achieve complete participation, however, the use of waivers could be tied to the state certification process.

Some lab directors have expressed interest in adopting for their own use the data base format developed for a central data bank, assuming software and training were provided. At least two-thirds of computerized labs have hardware systems capable of supporting dBase III plus or dBase IV. This might be a logical choice for central data bank software, because it has been selected as a DEQE standard for microcomputers. It may well be worthwhile to provide software and training to the labs, as an incentive for them to adopt a uniform data reporting format.

Concerns have been raised about the quality of the data presently available from the commercial laboratories. It is not always clear how and where samples are taken. Well drillers could submit samples from their own homes to avoid turning up any evidence of deficiencies in their drilling technique. Homeowners submitting samples may be poorly informed about proper sampling procedures. There is at present, however, no other source of extensive data about private well water quality. Costs of scientific monitoring on a large scale would be prohibitive. The use of data from commercial labs may be considered an affordable means of screening large numbers of private well samples. Where potential problems are discovered, further tests could be conducted. In addition, the degree of sophistication among well drillers, Boards of Health, and consumers has been increasing because of both education and regulation. As a result, the quality of water samples submitted should be improving.

TABLE OF CONTENTS

	Page
Abstract	i
Executive Summary	ii
List of Tables	vi
List of Figures	viii
I. Introduction	1
Defining the Problem	1
Objective of the Study	2
II. Review of Literature on Private Well Water in Massachusetts	3
Private Well Water Regulations	3
Conditions for Well Contamination	6
Types of Contamination	7
III. Methods of Study	11
Preliminary Interviews with Selected Private Labs	11
Design of a Survey to Determine Data Bank Feasibility	11
Investigation of Private Well Data Bases in Other States	12
Identifying Data Bank Users	12
IV. Results and Discussion	13
Preliminary Interviews with Private Labs	13
Assessment of Survey Results	14
Potential Users of a Statewide Private Well Data Bank	24
Appropriate Software Technology	27
Private Well Data Bank Systems in Other States	27
V. Summary and Conclusions	31
Summary of Survey Findings	31
Options for Creating a Data Bank	32
Bibliography	38
Appendix A: Summary of Preliminary Interviews with Selected Commercial Environmental Laboratories	40
Appendix B: Survey Questionnaire	46
Appendix C: Compilation of Survey Responses from Commercial Certified Environmental Laboratories	51
Appendix D: Listing of Massachusetts Commercial Environmental Laboratories and Their Test Certifications	55
Appendix E: Listing of Contacts from Potential User Pool	60

LIST OF TABLES

Table	Title	Page
1	Microbiological, Inorganic and Organic Contaminant Limits	4
2	DEQE Drinking Water Guidelines	5
3	Major Sources of Known Well Contamination	7
4	Questions Used for Preliminary Interviews	12
	Responses to Survey Questionnaire:	
5.1	Approximately How Many Different Private Wells Has Your Lab Tested in the Past Year?	15
5.2	Does Your Lab Perform Any Uncertified Analyses?	16
5.3	Do Your Data Include Any Information About Physical Characteristics of the Wells or Proximity to Possible Sources of Contamination?	17
5.4	Do Your Data Identify Why a Well is Being Tested?	17
5.5	Are Private Well Water Quality Data Stored on Computer Disks or Data Sheets?	18
5.6	If Data Are Stored on Computer Disks, What Format Do You Use?	18
5.7	Can Your Computer Be Converted/Downloaded into ASCII Format?	19
5.8	Might You Be Willing to Provide Existing Private Well Water Quality Data to a State Data Bank?	19
5.9	In What Manner are Well Locations Identified?	20
5.10	Along With Test Results, What Sort of Well Location Information Would You Be Willing to Release Without a Waiver from the Well Owner?	21
5.11	Estimated Employee Time to Provide Existing Computerized Information	21
5.12	Would You Be Willing to Ask Well Owners to Sign a Release Form so that Complete Records for Future Data Could be Contributed to a State Data Bank?	22

LIST OF TABLES (cont'd)

Table	Title	Page
5.13	Would You be Willing to Provide New Well Water Quality Data to a Data Bank in the Future? What Reporting Frequency Would Be Best?	23
5.14	How Much Time would you Estimate would be Needed by an Employee to Provide Incoming Data on a Regular Basis?	24
5.15	Would you be Willing to Supply Data Only if a Compensation Rate per Hour Were Arranged?	24

LIST OF FIGURES

Number	Title	Page
1	Towns with Contaminated Private Water Supplies	8

I. INTRODUCTION

In recent years it has become clear that groundwater is vulnerable to contamination from a variety of sources. Pesticides, road salt, petroleum, and other toxic substances have been detected in public and private wells. In many states, including Massachusetts, the extent of the problem with respect to private wells, in particular, has been difficult to assess because of a paucity of private well water quality information. The present study was undertaken to assist the Massachusetts Department of Environmental Quality Engineering (DEQE) in assessing the feasibility of creating a private well water quality data bank. It may be considered part of a nationwide response to contamination problems associated with groundwater resources.

Both in Massachusetts and nationwide, contamination of groundwater is a serious problem, the full extent of which is still being discovered. Massachusetts receives more than forty inches of rainfall annually, and has abundant groundwater, which is the primary water source for about 2 million people, about 35% of the population (Frimpter, 1986). Private wells serve approximately 400,000 people or 7% of the population (DEM, 1984).

Defining the Problem

Public groundwater supplies are carefully monitored and regulated, but private wells are only minimally regulated. Some local Boards of Health require testing of wells at new homes before a building permit is issued. These requirements vary from coliform testing only to a considerable number of tests, including bacteria, pH, hardness, alkalinity, nitrates, and metals. Older wells in the Commonwealth are usually tested only if the homeowner decides to test, or if a mortgage lender requires testing as a condition of property transfer. Many older wells have never been tested. Although hundreds of public and private wells have been closed because of organic contaminants such as pesticides and PCB's, there is no requirement to test for these substances in private wells.

Private well water quality guidelines are due to be released to Boards of Health by the Massachusetts Department of Environmental Quality Engineering in the Summer of 1989. These guidelines are intended to assist the Boards in providing better regulatory protection for private wells to be drilled in the future.

Locations and even numbers of private wells in Massachusetts are poorly documented. Little is known statewide about overall quality or levels of specific contaminants in private well water. However, many private wells have been tested by the 55 commercially owned certified laboratories in the state at the request of well owners or users, Boards of Health, or banks. Potential benefits from consolidating this information into a centralized data bank include the following:

1. identification of contamination sources and possible protection strategies

2. guidance in designing educational programs for well owners

3. assistance to local officials in protecting public health

4. aid to state agencies in managing and protecting drinking water quality in the Commonwealth.

Objective of the Study

This study is designed to determine the feasibility of creating a central private well water quality data bank. Several issues are addressed: potential data bank users, ability to transfer computerized data to a central data base system, the comprehensiveness of information that is potentially available, cost, and confidentiality of information.

II. REVIEW OF LITERATURE ON PRIVATE WELL WATER IN MASSACHUSETTS

About 400,000 people rely on private wells in Massachusetts. There are private wells in 275 of 351 municipalities; in 61 towns, residents are completely dependent on private drinking water supplies. Roughly 6,000 new private wells are drilled in Massachusetts each year (DEM). A private water supply is defined as "any potable non-public water supply", where "non-public means any water supply system which serves fewer than 15 connections or fewer than 25 individuals" (EOEA, 1987).

Private wells in Massachusetts draw water from two types of aquifers, classified as water-table and artesian. Water-table aquifers are not confined by an upper impermeable layer. Water is virtually at atmospheric pressure, and the surface of the well is equivalent to the zone of saturation or water table. Artesian wells are confined by an upper impermeable layer causing greater than atmospheric pressure, so that water in the well rises above the confining layer or from the surface of the ground (Gibson and Singer, 1971). Water-table wells are more prone to contamination by percolation through permeable soil. Artesian wells may be contaminated by pollution travelling long distances along the impermeable layer until a crack is encountered.

There are four principal types of aquifers which provide drinking water in Massachusetts: stratified drift; sedimentary-bedrock; crystalline, metamorphic and igneous rock; and carbonate rock. Nearly all public water supplies are from stratified drift aquifers. Private wells are mainly located in bedrock aquifers, except on Cape Cod where most wells are drilled into stratified-drift aquifers (Frimpter, 1986). The Cape Cod aquifer is unconfined and highly permeable, which causes it to be particularly susceptible to contamination (Committee on Ground Water Quality Protection, 1986).

Private Well Water Regulations

There are few regulations concerning private wells in Massachusetts. State law (M.G.L c.21, s.16) requires that well drillers be registered and that they submit Well Completion Reports to the Department of Environmental Management after drilling a new well. State law (M.G.L. c.40, s.54) also requires that an acceptable water supply be available before a building permit is issued. In addition, Title 5 of the Environmental Code requires a distance of 100 feet between a septic system and a well. The state Pesticide Board has specified a minimum distance of fifty feet from private wells for herbicide applications (333 CMR 11.00). Boards of Health have the authority to regulate installation of new wells (M.G.L. c.111, s.31, 122, 122A, 127, 143, 155, 187 and 188).

To protect public health, DEQE has established drinking water standards and guidelines for a large array of potential contaminants that may affect both public and private water supplies. Contaminant limits for microbiological contamination, inorganic chemicals and organic chemicals are shown in Table 1.

TABLE 1

Microbiological, Inorganic and Organic Contaminant Limits*

Contaminant	Maximum Contaminant Level
Bacteria	
Coliform	Membrane Filter Technique 1 Colony/100 ml of the Arithmetic Mean of all Samples Fermentation Tube Method Coliform shall not be present in more than 10% of the tubes in any one month
Inorganic Chemical	(in milligrams/liter)
Arsenic (As)	0.05
Barium (Ba)	1.0
Cadmium (Cd)	0.010
Chromium (Cr +6)	0.05
Fluoride (F)	4.0
Lead (Pb)	0.05
Mercury (Hg)	0.002
Nitrate (NO3)	10.0
Selenium (Se)	0.01
Silver (Ag)	0.05
Sodium (Na)	20.0
Organic Chemical	(in milligrams/liter)
1,1,1-Trichloroethane	0.20
1,1-Dichloroethylene	0.007
1,2-Dichloroethane	0.005
2,4,5-TP Silvex	0.01
2,4-D	0.1
Benzene	0.005
Carbon Tetrachloride	0.005
Endrin	0.0002
Lindane	0.004
Methoxychlor	0.1
Para-Dichlorobenzene	0.005
Toxephene	0.005
Trichloroethylene	0.005
Trihalomethanes (Total)	0.1
Vinyl Chloride	0.0002

* Based on DEQE (1988)

Guidance is also issued by DEQE for chemicals other than those with maximum contaminant levels. These limits are helpful to Boards of Health and to consumers in interpreting well test results. Proposed guidelines are shown in Table 2.

TABLE 2

DEQE Drinking Water Guidelines*

Contaminant	DEQE Guideline
Substance	(in mg/Liter)
Acetone	0.700
Alachlor	0.002
Aldicarb	0.010
Atrazine	0.001
Bis-(2-Ethylhexyl)-Phthalate	0.010
Bromomethane	0.010
Carbofuran	0.010
1,2-Dibromo-3-Chloropropane	0.0002
o-Dichlorobenzene	0.600
Dichloromethane	0.005
1,2-Dichloropropane	0.001
1,3-Dichloropropene	0.002
Dinoseb	0.005
1,4-Dioxane	0.050
Ethylbenzene	0.700
Ethylene Dibromide	0.00004
Ethylene Glycol	5.5
Methyl Ethyl Ketone	0.350
Methyl Isobutyl Ketone	0.350
Methyl tertiary Butyl Ether	0.050
Metolachlor	0.008
Oxamyl	0.050
Styrene	0.005
Tetrachloroethylene	0.005
Toluene	2.000
Xylenes	1.0
Beta Particles and Photons (annual dose)	mrem/yr
Gross Alpha Particle Activity (excluding U and Rn)	15 pCi/Liter
Radium (226 & 228)	5 pCi/Liter
Radon	10,000 pCi/Liter
Uranium	10 pCi/Liter

* DEQE

Conditions for Well Contamination

Many conditions may affect the vulnerability of private wells to pollution. Foremost is climate, including rainfall and air temperature. In temperate regions with substantial rainfall such as Massachusetts, the likelihood that contaminants will be transported is increased. Air temperature is a factor because frozen soil in the unsaturated zone (above the aquifer) and in the upper water table create a hydraulic barrier.

The other most important factors in well vulnerability are well depth and soil type. Depth is important because toxins that travel long distances stand a greater chance of being diluted or degraded prior to contact with well water. Soil properties vary greatly in Massachusetts and are of paramount importance in determining the infiltration rate of pesticides and other toxins. The following is a summary of soil characteristics and the respective effects of each component (USEPA, 1987):

1. Clay content: Clay minerals in the soil provide cation (positively charged elements or molecules) exchange properties that bind positively charged chemicals. Clay particles are relatively small and therefore provide a relatively large surface area per particle which contributes to adsorption capacity.

2. Organic matter content: A high organic matter content contributes to pesticide sorption in soils. Pesticide application to organically rich soil is often greater than for soils that are primarily composed of inorganics.

3. Soil texture: Texture relates to the proportions of silt, clay, and sand in soil. Coarse soils with a large percentage of sand allow more rapid and deeper leaching than fine or heavy-textured soils.

4. Soil structure: Structure refers to the larger aggregates of the soil including plates, prisms, blocks, and uniform grains. Water and contaminants may percolate through cracks in the soil structure. Cracks or channels may be prominent, resulting from burrowing worms and other soil biota allowing increased infiltration.

5. Porosity: Porosity is a function of total pore space and size in soils. Properties that affect porosity include soil texture, aggregation and particle shape. More porous soils provide rapid water or contaminant transport.

6. Soil moisture: Interstitial water of soils dissolve and transport contaminants that are not adsorbed to particle surfaces. Upward movement is also possible via capillary action and evapotranspiration.

Based on quantitative analysis of these factors, groundwater in Massachusetts is considered to be highly vulnerable to contamination, except in the extreme western portion of the state (USEPA, 1987).

Types of Contamination

In Massachusetts and New England generally, there are six primary ways in which groundwater may become contaminated (Kaynor, 1988). These contamination sources are presented in Table 3, along with the number of wells that have been contaminated by each. In total, there have been at least 636 private well closures in 120 communities within the past 15 years (Weintraub, 1988). Figure 1 depicts towns in Massachusetts that have reported private well contamination.

TABLE 3

Major Sources of Known Well Contamination

Contaminant	Source*	# of Wells Over Guideline**
Chemicals	Landfills, Household Contaminants	169
Petroleum	Leaking Underground Storage Tanks, waste oil, degreasing compounds	67
Pesticides	Agriculture, Lawns, Rights of Way	77
Sodium	Road Salt, Road Salt Stock Piles	163
Bacteria and Nitrates	Septic Systems	***
Other	Metals, Radon, Arsenic, Salt Water Intrusion	NA
	Total	636

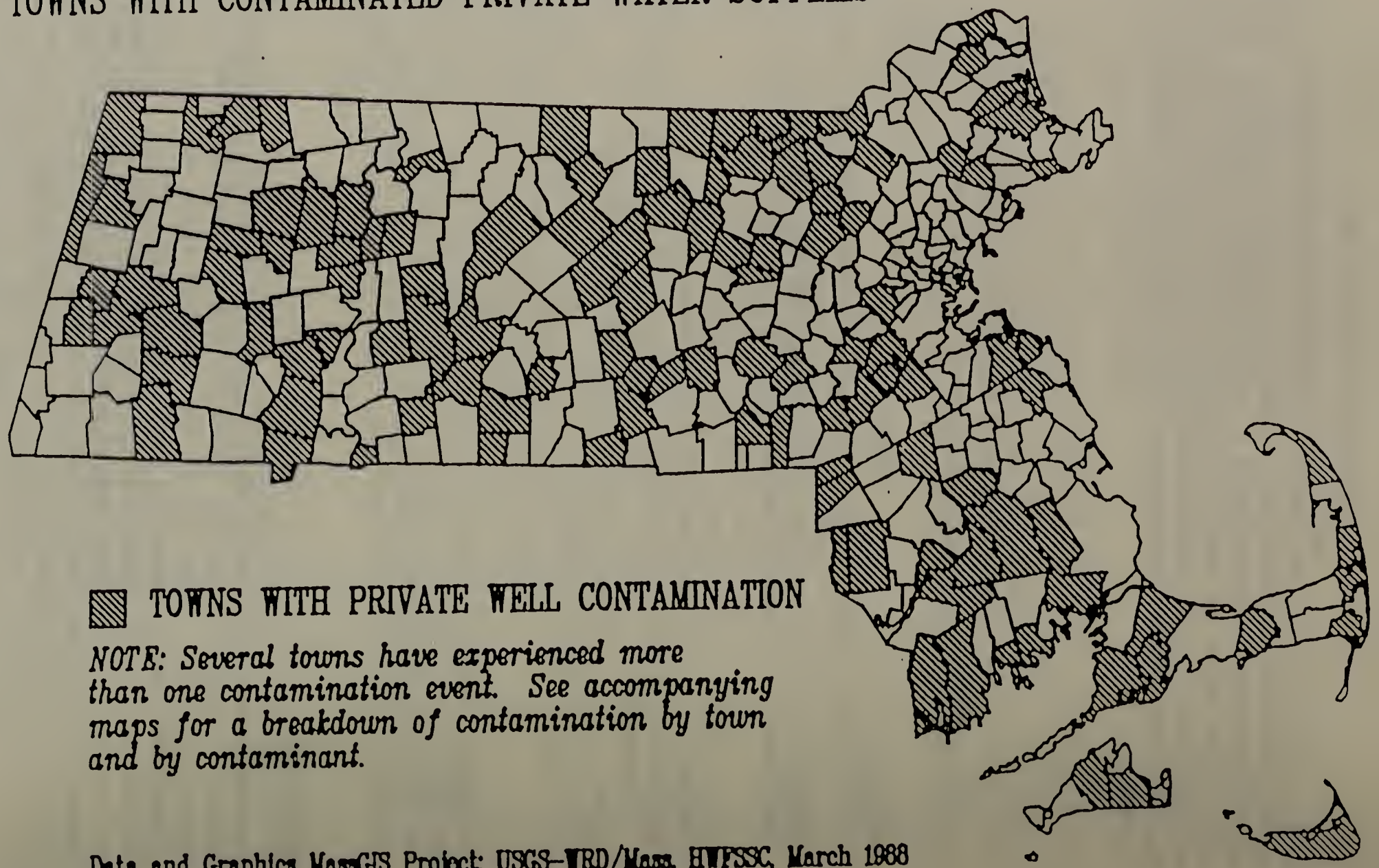
* Kaynor (1988)
** Weintraub (1988)
*** 40 Communities Affected
NA Not Available

Chemicals

Landfills may be a particularly important cause of contamination in the future. Massachusetts has about 250 active and 600 inactive municipal solid waste landfills. Very few of the landfill sites and none of the 13 superfund sites have been sealed from leaching (Kaynor, 1987). The Massachusetts Bureau of Solid Waste Disposal (1985) estimates that 40% of the landfills are already polluting the groundwater or threaten to do so. When landfills are not sealed properly, they may leach chemicals almost indefinitely. Landfills created during the Roman Empire are still producing leachate (Driscoll, 1986).

FIGURE 1

TOWNS WITH CONTAMINATED PRIVATE WATER SUPPLIES



TOWNS WITH PRIVATE WELL CONTAMINATION

NOTE: Several towns have experienced more than one contamination event. See accompanying maps for a breakdown of contamination by town and by contaminant.

Data and Graphics MassGIS Project; USGS-WRD/Mass. HWFSSC, March 1988

Petroleum

Approximately 40,000 underground storage tanks exist in Massachusetts. It has been estimated that some 8,000 or 20% of these may be currently leaking (Kaynor, 1988).

Pesticides

An example of the potential for undetected problems came to light in 1984 in Whately, Massachusetts (Sarnat et al., 1987). An inquiry by a local resident prompted the state to test private wells for the agricultural fumigant ethylene dibromide (EDB) and the pesticide aldicarb. The inquiry was made after a report released in August, 1969 reported aldicarb (trade name Temik) residues in Suffolk County, Long Island, New York. A subsequent study showed 1000 of 8000 wells sampled in Suffolk County to be contaminated with aldicarb, resulting mainly from application to potato fields. Whately and other communities also had potato fields in which Temik had been used, with soil conditions similar to those found in Long Island. Sampling in Whately and other areas, mainly in the Connecticut Valley, revealed that of 327 wells tested (311 of them private) 67 were contaminated with Temik and 22 exceeded the state guideline (Scarano, 1986).

Use of pesticides may actually be on the rise. A study of the Connecticut River Valley indicated that although agricultural acreage declined from 84,964 in 1972 to 50,735 in 1985, the total quantity of pesticide use increased over the same period (Stone and Webster, 1988).

Sodium

Sodium contamination continues to be a problem in Massachusetts, where salt is used for road de-icing. A total of 38 communities have reported private well contamination due to road salt application or salt stockpiles (Weintraub, 1988).

Bacteria and Nitrates

Possibly the most commonly encountered source of private well contamination is improperly functioning or inadequate septic systems. This problem is particularly important on Cape Cod, where the water table is shallow and the drinking water aquifer unconfined. A study by Persky (1986) showed a correlation between nitrate levels and housing density. The Cape was divided into 18 sample areas containing 3,468 private and public wells. Of the nine sample areas with housing density greater than 1 house/acre, 5 had nitrate levels of 5 mg/l or greater in 25% of all wells. In contrast, only one of the nine less densely populated areas had comparable nitrate levels.

Other Sources

In addition to the other contamination sources listed, acid precipitation may be increasing the level of aluminum and other heavy metals in well water. A study by Baker (1986) showed that increasing acidity of soils in Amherst and other communities in the Quabbin vicinity probably contributes to a more soluble aluminum content.

Other sources of contamination include radioactivity from radon and uranium, arsenic, and salt water intrusion.

Many contamination problems in private wells may yet be undetected. Survey responses from 115 Massachusetts Boards of Health (of 351 surveys mailed) indicated that only 46 maintain records other than bacteriological results (Godfrey et al., 1986). Well locations based on house plots are not computerized by Boards of Health in most cases or accessible in a central data bank. Furthermore, only 23 towns that require water quality monitoring require well testing when property is transferred according to Weintraub (1988).

III. METHODS OF STUDY

Preliminary Interviews with Selected Private Labs

The Private Well Water Quality Data Bank Feasibility Study was designed to determine what information might be available from the 55 commercial environmental laboratories in Massachusetts. A list of state-certified laboratories was provided by the Lawrence Experimental Station (Appendix D). Directors of four labs were contacted for preliminary interviews, to aid in designing a questionnaire to be used in a survey of all 55 labs. The labs selected for preliminary interviews were: Tighe and Bond Inc. in Easthampton, J and W Laboratory in Millers Falls, Berkshire Enviro-labs in Lee, and Lycott Environmental Research in Southbridge. The preliminary interviews were carried out between February 15 and March 2, 1989.

The four interviews were based on the questions presented in Table 4. The intent was to determine the type of private well data collected, the manner in which the data are stored, and the availability of the information for use in a centralized data bank. Laboratory directors were also requested to express concerns or problems they might foresee in creating a data bank.

Design of a Survey to Determine Data Bank Feasibility

The survey questionnaire sent to all commercial laboratories consisted of eighteen multiple choice questions (Appendix B). The survey was mailed on March 15, 1989. Allowing two days for mail dispersal, lab directors were given more than two weeks to return the survey which was estimated to require five to ten minutes to complete. Telephone follow-ups were initiated on April 5 for those labs that had not returned the questionnaires.

The questionnaire was organized into four areas of concern. Questions 1 through 6 requested information on the number of private well tests performed, lab certification for tests performed, and well physical characteristics. Questions 7 through 10 dealt with the manner in which data are stored and the possibility of converting computerized data to a form that could be transferred to a centralized data bank. Questions 11 through 14 considered availability of stored data, confidentiality with respect to well location, and the time which might be required to transfer the data. Questions 15 through 18 dealt with data which labs will be generating in the future, including the use of owner release forms to permit use of complete well addresses, optimal frequency of data transfer, and compensation desired by the labs.

Prior to mailing, the survey was pretested to verify its clarity and completeness. The director of the DEQE water lab at the University of Massachusetts, Amherst, was asked to complete the questionnaire and comment on any aspect of the survey.

TABLE 4

Questions Used for Preliminary Interviews

1. Which private well water analyses are typically performed by your lab and which parameters are "farmed out" to other labs?

2. In what form are data recorded?

3. What methods of analyses are used?

4. Are private well data available to anyone besides well owners?

5. Do water labs use release forms or some notification process to owners concerning necessary well information disclosures?

6. Would you be willing to supply data to a government agency?

7. What suggestions do you have that would make data transfer as easy as possible?

8. What areas of concern do you feel other labs might have?

9. Do you keep data pertaining to well physical characteristics or distance relation to contaminating sources?

Investigation of Private Well Data Bases in Other States

By agreement with DEQE, several other states that currently have data bank systems in place for private well water quality were consulted. The states interviewed--Wisconsin, New York, Rhode Island and New Hampshire--were suggested by members of the Technical Advisory Committee. Information gained from these interviews helps to provide background for determining alternative designs for creating a data bank system in Massachusetts.

Identifying Data Bank Users

Potential users of a private well water quality data bank were identified to assure that, if created, the data bank would provide pertinent information while avoiding collection of unnecessary data. The researchers contacted by phone individuals in state agencies, the University and the private sector who were known to have an interest in such a data bank. Referrals from them in turn provided additional names. The potential user pool identified includes groups in government, academic departments, and the private sector. A listing of those contacted appears as Appendix E.

IV. RESULTS AND DISCUSSION

Preliminary Interviews with Private Labs

Four preliminary interviews were conducted during late February and early March of 1989 to guide the design of the survey. The participating Massachusetts laboratories included Tighe and Bond Laboratory, J & W Laboratory, Lycott Environmental Laboratory, and Berkshire Enviro-Labs. Complete summaries of the interviews appear in Appendix A.

Tighe and Bond

Tighe and Bond is certified to perform all drinking water tests certified by DEQE. This lab regularly performs private well water analyses. Information is stored in a computerized custom designed data base. The lab manager was amenable to contributing data to a central data bank if specific locations of private wells would not be disclosed. He felt that release forms signed by well owners would make a data base more complete in that addresses could then be provided. This system was successful in the 1980's when Tighe and Bond tested numerous private wells as part of a DEQE study. The manager felt that considerable employee time might be necessary to provide data, so compensation for Tighe and Bond would be required.

J & W Laboratory

J & W lab routinely performs conventional analyses on private well water samples. They have computerized their data on an Apple IIe data base management system for the past three years. The lab manager expressed an interest in participating in creating a central data bank and would be willing to request owner signatures on release forms. He suggested that there may be a problem distinguishing between certified and uncertified tests from the records of commercial labs.

Berkshire Enviro-Labs

Berkshire Enviro-Labs performs many private well tests in the western part of the state, where public water supplies are less common. It is not currently using any computer software to store test results. Extensive paper files are maintained dating back to the 1970's. The director suggested the state devise a suitable data base that could be distributed to all commercial labs. This would aid data collection greatly.

Lycott Environmental Research

Lycott regularly performs private well water tests for people in central Massachusetts. The firm dates back to the early 1970's. It became computerized in 1985, and currently use R-base for data storage. The lab

would be willing to contribute to a central data base identifying well location by town only unless release forms were used. The manager believes the state should provide public education concerning private wells for the benefit of local Boards of Health and the public.

Assessment of Survey Results

The survey questionnaire (Appendix B) was mailed to all 55 certified commercial laboratories in Massachusetts. A total of 24 labs responded by mail within three weeks. The remaining 31 labs were contacted by telephone. The combined contacts included all 55 certified labs, for a 100 percent rate of contact. Three lab managers chose not to complete the survey. Fourteen other returns indicated the labs did not test private well water. The following results are based on responses from the remaining 36 labs.

Survey responses are summarized in this section in Tables 5.1 to 5.15. Appendix C provides a complete compilation of survey responses.

Private Well Testing

Table 5.1 indicates the number of private wells tested during the one-year period from March 1, 1988 to February 28, 1989. Of the 36 labs that performed private well tests, 18 analyzed fewer than 100 wells per year. Eight labs tested between 101 and 400. These labs therefore account for 26 of 36 labs or over 72%. The remaining 12 labs tested between 500 and 5000 private wells per year.

A similar distribution was shown among the 20 labs with computerized data. Twelve reported testing fewer than 100 wells. The other 8 tested between 101 and 4000 private wells per year.

A total of 22,808 private wells were tested by commercial labs during this one year period. Although 72% of the labs reported testing 400 or fewer private wells during the year, most of the wells (19,775) were tested by the remaining 28% of the labs. In fact 87% of wells were tested by only ten labs.

Computerized records exist for 13,150 or 58% of tests performed. A point which may be of interest in terms of data base feasibility is that 12,100 of the 13,150 computerized tests were performed by only six labs.

Several labs reported that their records may not indicate private wells that were tested by request of engineering firms acting as intermediaries for well owners. These samples may not be identified as being from private wells. There is no way at present to determine the extent of this practice.

In response to Question 2 of the survey, respondents estimated that about 12% of wells were tested more than once.

TABLE 5.1

Approximately How Many Different Private Wells has Your Lab Tested in the Past Year (March 1, 1988 - February 28, 1989)?

Survey Response

# of Wells	All Labs Responding	Labs with Computerized Data
0	14	--
1 - 100	18	12
101 - 200	3	1
201 - 300	3	1
301 - 400	2	0
401 - 500	0	0
501 - 600	2	1
601 - 700	0	0
701 - 1000	2	1
1001 - 1500	3	2
1501 - 2000	0	0
2001 - 3000	0	0
3001 - 4000	2	2
4001 - 5000	1	0
Total # of Labs	50*	20
Total wells tested	22,808	13,150

* 36 labs tested private wells

Uncertified Analyses

There are two circumstances under which a lab might perform analyses that are not certified by the state. The first and more common occurs when the analyses being performed are not included in the state certification program, for example tests for certain pesticides. The second case occurs while a lab is waiting for certification for a specific parameter. With the knowledge that certification is pending, a well owner may request the test(s) to be performed. It is important in creating a data bank that these instances be noted in order to obtain the most reliable information and inform data users which test results have been performed under certification, assuring quality control.

The labs were asked if some of their data output was from uncertified tests and whether this information was discernible from certified test results. Table 5.2 shows that about half of all labs reported performing uncertified tests. This was also true of labs with computerized data. Computerized labs performing uncertified tests were also asked whether their records

distinguish these from certified analyses. Nine out of ten responded that they do.

TABLE 5.2

Does Your Lab Perform Any Uncertified Analyses?

Survey Response

Response	All Labs Responding	Labs with Computerized Data	Can Computerized Records Be Distinguished Between Certified and Uncertified Tests?
Yes	17	10	9
No	18	10	0
No Answer	1	0	1
Total	36	20	10

Physical Characteristics of Private Wells and Proximity to Contamination

Determining the causes of well contamination may be aided by knowing physical characteristics of private wells, such as well depth and proximity to possible sources of contamination. Table 5.3 shows that only 7 labs record well depth, 3 the existence of a possible contaminant source, and 2 the distance from such a source. The rest do not record any such information. Among labs with computerized data, 2 record well depth, 2 contaminant sources, 1 notes the distance from a polluting source, and 17 do not list this type of information.

Identifying Why a Well is Tested

Information about why a well is being tested might aid data bank users to determine possible contamination problems in nearby wells. It may also be useful to know if a well is being tested by request of a bank, well owner, or government agency. Results in Table 5.4 indicate that 32 of 36 labs do not identify why a well is being tested. Labs with computerized data do not record why a well is tested in 17 of 20 cases.

Local Groups Involved with Water Quality

Question 6 in the survey requested a listing of any local groups that are gathering private well water quality information. Aside from Boards of Health, the only group mentioned was the Norwell Groundwater Study Committee.

TABLE 5.3

Do Your Data Include Any Information About Physical Characteristics of the Wells or Proximity to Possible Sources of Contamination?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Well Depth	7	2
Soil Type	0	0
Possible Contamination Source (e.g. septic system)	3	2
Distance From Contamination Source	2	1
No Information Available	26	17
Other*	2	1

* Age, well type, yield

TABLE 5.4

Do Your Data Identify Why a Well is Being Tested?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Yes	4	3
No	32	17
Total	36	20

Method of Data Storage

Table 5.5 indicates that only 10 of 36 responding labs were in business prior to 1980, and only one had computer capabilities at that time. By 1989, 20 labs were using computerized systems, with 16 still using data sheets.

The 20 labs using computers were asked the format in which data are presented. Table 5.6 shows that 20 different software systems are being used by the 20 labs. A uniform data base system used by all the labs would expedite transfer of data to a central data bank. However, different software packages may be

compatible, especially if the data can be converted to ASCII (text) format for input into the central data bank.

TABLE 5.5

Are Private Well Water Quality Data Stored on Computer Disks or Data Sheets?

Survey Response

Number of Labs Using:	Year 1980	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89
Data Sheets	9	11	11	13	16	16	17	18	21	22	16
Computer Disks	1	1	2	2	3	4	8	9	11	13	20
Total	10	12	13	15	19	20	35	37	33	35	36

TABLE 5.6

If Data are Stored on Computer Disks, What Format do You Use?

Survey Response

Format	# of Labs
Apple IIE Data Base	1
Custom (Tandy, Prime, 2 other systems)	4
dBase III Plus	1
Gemini Lab Information System	1
HP Software	2
J Language	1
Mass Spec EPA Format/Perkin Elmer Data Base	1
Microsoft Excel (Apple Mac.)	1
PCF & PC File Plus	1
rBase 5000	1
RSI	1
Word Processor	3
Don't Know	2
Total	20

Transferring Data to a Central Data Bank

Data converted to ASCII format could be stored on floppy disks and mailed, or transferred to a central computer directly through a modem. As shown in Table 5.7, 13 of the 20 labs with computerized data believed they could convert to ASCII format; 4 others were unsure. Half of the 20 labs with computerized data have modems.

TABLE 5.7

Can Your Computer Data Be Converted/Downloaded into ASCII Format?

Survey Response

Response	# of Labs	Computer Has Modem
Yes	13	9
No	3	10
Unsure	4	0
No Response	0	1
Total	20	20

Accessing Computerized Data

Most labs in the survey expressed willingness to provide existing private well quality data (Table 5.8). More than 72% of labs responding (26 of 36) expressed willingness, as did 16 of 20 labs with computerized data. These 16 computerized labs tested a total of 9,490 wells in the past year.

TABLE 5.8

Might You Be Willing to Provide Existing Private Well Water Quality Data to a State Data Bank?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Yes	26	16
No	10	4
Total	36	20

Well Location Identification

The usefulness of a central data bank would depend in part on knowing the locations of private wells. Mapping well locations may be instrumental in using contamination data to screen for impending infiltration to nearby wells. Table 5.9 shows that 27 of the 35 labs responding keep records of well address, owner address or both. Labs with computerized data store both or well location only in 15 of 20 cases.

TABLE 5.9

In What Manner are Well Locations Identified?

Survey Response

Location	All Labs Responding	Labs with Computerized Data
Address of Well Location	3	2
Address of Owner	8	5
Both	24	13
No Response	1	0
Total	36	20

Many private labs are concerned about confidential information. Table 5.10 identifies the sort of well location information that the labs would be willing to supply without use of an owner signed release form. Responses indicated that most labs were concerned about identifying exact locations of private wells. Twenty-six of 33 labs were willing to provide at most, town name. In fact 14 of the labs, including 7 of 20 computerized labs, were not willing to divulge any location data without release forms signed by well owners.

Providing Existing Data

Existing data that could be collected would almost necessarily need to be computerized. Transferring and inputting archived information stored on data sheets could prove to be time consuming. Table 5.11 provides expected employee time estimated by lab managers to provide existing computerized information. A wide distribution of times was reported by 15 labs ranging from 1 lab that estimated 15 minutes would be required, up to 4 labs that figured more than 40 hours were needed.

These times should be considered very rough estimates. It is important to note that lab managers did not know specifically which years or what data they would be making available.

TABLE 5.10

Along With Test Results, What Sort of Well Location Information Would You Be Willing to Release Without a Waiver From the Well Owner?

Survey Response

Location	All Labs Responding	Labs with Computerized Data
Street Address	3	2
Street Name Only	4	2
Approximate Longitude and Latitude	0	0
Town Name Only	11	8
None	14	7
Other*	1	1
No Response	3	0
Total	36	20

* One lab responded "discussion needed".

TABLE 5.11

Estimated Employee Time to Provide Existing Computerized Information

Survey Response

Time	Labs with Computerized Data
15 Minutes	1
1 Hour	0
5 Hours	4
10 Hours	2
20 Hours	1
40 Hours	2
More than 40 Hours	4
No Response	6
Total	20

Well Owner Release Forms

Use of well owner release forms would circumvent confidentiality and legality issues concerning well locations and water quality data. More complete incoming data could be provided if labs made release forms available. Obtaining release forms for existing data would likely be impractical. Table 5.12 shows that most labs responded positively toward requesting owner release signatures, with 31 of 36 labs responding either "yes" or "possibly". All but 1 of the 20 computerized labs answered "yes" or "possibly". The number of wells tested in one year by these 19 labs was 9,650.

Providing New Private Well Water Data

Some 34 of 36 labs answered "yes" or "possibly" to the idea of providing incoming well water quality data in the future (Table 5.13). All 20 of the labs with computerized data responded "yes" or "possibly". These responses indicate the feasibility of creating a data bank under the right conditions.

Nearly half of lab managers (15 of 32) felt a quarterly system of reporting would be best for them. Nine of the remaining 17 would prefer a monthly arrangement. Similarly, 9 of the 20 labs with computerized data chose a quarterly system and 5 picked the monthly option.

TABLE 5.12

Would You Be Willing to Ask Well Owners to Sign a Release Form so that Complete Records for Future Data Could be Contributed to a State Data Bank?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Yes	16	9
No	5	1
Possibly	15	10
Total	36	20

Employee Time to Provide Incoming Data

One manner in which to determine the feasibility of creating a data bank is by the time needed for lab employees to provide information on a regular basis. In Table 5.14 it is noteworthy that all but one of the lab managers estimated that 5 hours per week or less would be needed to provide incoming data to a data bank. Twenty-three of the 32 estimates were that no more than 1 hour per week would be needed. For labs with computerized data, 15 of 20 responses

were 1 hour per week or less. As with time estimates for existing data, this information must be considered at best speculative due to a current lack of a specified procedure for contributing to a central data base system.

TABLE 5.13

Would You Be Willing to Provide New Well Water Quality Data to a Data Bank in the Future?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Yes	16	9
No	2	0
Possibly	18	11
Total	36	20

If Your Answer is "Yes" or "Possibly", What Reporting Frequency Would be Best?

Frequency	All Labs Responding	Labs with Computerized Data
Monthly	9	5
Quarterly	15	9
Semiannually	5	4
Annually	3	2
No Response	4	0
Total	36	20

Laboratory Compensation

The final question of the survey addressed compensation that might need to be paid to the labs for employee time required to participate in a central data base system. About half (15 of 32) of the labs and 10 of 18 labs with computerized data indicated they would require compensation, as shown in Table 5.15.

TABLE 5.14

How Much Time Would You Estimate Would Be Needed By an Employee to Provide Incoming Data on a Regular Basis?

Survey Response

Time	All Labs Responding	Labs with Computerized Data
Practically None	3	2
1 Hour/Month	3	1
1 Hour/Week	17	12
5 Hours/Week	8	4
10 Hours/Week	0	0
Other	1	1
No Response	4	0
Total	36	20

TABLE 5.15

Would You Be Willing to Supply Data Only if a Compensation Rate Per Hour Were Arranged?

Survey Response

Response	All Labs Responding	Labs with Computerized Data
Yes	15	10
No	17	8
No Response	4	2
Total	36	20

Potential Users of a Statewide Private Well Data Bank

Data bank users can be categorized into three groups: government agencies (state, local, and federal), academics in various fields of research, and the private sector.

Government Agencies

Department of Environmental Quality Engineering. The following offices or divisions of DEQE have been represented on the Technical Advisory Committee for this project: Office of Research and Standards, Division of Water Supply, Information Center, Division of Hazardous Waste, Office of Special Projects and Office of Right to Know.

Department of Environmental Management. The Department of Environmental Management's Division of Water Resources has been concerned about the emphasis in this project on data from commercial laboratories. An increasing amount of data, including private well water quality test results, is generated by Boards of Health as part of the permit process for new wells. These tests are public domain and not subject to confidentiality restrictions. It should be emphasized, however, that any such data are generated by the commercial labs. Through the use of an appropriate waiver form by the labs, test results which are public information could be identified and retrieved, without the need for owner permission. It will be easier to obtain the results from 36 labs than from 252 Boards.

Some users have suggested that the utility of a data bank could be improved by incorporating, for new wells, the information in Well Completion Reports that are required by law and collected by DEM.

Department of Public Health. The Department of Public Health includes several divisions that might benefit from a private well water quality data bank including: the Center for Health Promotion, Environmental Disease Prevention and its Division of Environmental Epidemiology and Toxicology studies. A private well water quality data bank could fill a significant gap in the existing environmental data needed for their epidemiological analyses of communities or regions. They expressed some concern, however, that the scope of testing routinely or sporadically performed on private wells may be too general for their needs, since they tend to look for specific contaminants. However, even basic water quality data would increase their current sources of information.

Department of Food and Agriculture. The Department of Food and Agriculture's Pesticide Bureau is represented on the Technical Advisory Committee for this project. According to Bureau staff, the data bank may be of limited value to them, because they would already know of most established cases of contamination, and because private citizens do not routinely test for pesticides. On the other hand, DFA could contribute its own data on pesticide contamination of private wells to the data bank to make such data more widely available.

Boards of Health. Boards of Health have only recently become involved in private well protection and regulation. They have collected little water quality data in the past, except what may have emerged from a specific crisis. As the Boards begin to pass new regulations, they will be receiving water quality data routinely from test results for new wells. These results are generated by the commercial laboratories. It is safe to assume that the commercial labs would be better equipped than numerous local Boards to be data providers.

The Boards would benefit in two ways from creation of a centralized data bank. First, it might provide them with information, particularly concerning contamination of older wells, to which they may not otherwise have access. Second, the data bank might permit them to utilize more systematically information which has been generated by their own regulations. Many towns suffer from insufficient data management and constant turnover among local officials. The data bank would help to 'safeguard' the Board's own data. All such data would allow Boards to design well protection strategies based on coherent water quality information.

Environmental Protection Agency. The Environmental Protection Agency already collects groundwater data for all states to assess pollution problems. This data bank would provide them with additional private well water quality data that is currently unavailable.

University of Massachusetts. The many departments on campus involved with water quality research could all benefit from a private well water quality data bank. These include: Agricultural and Resource Economics, Water Resources Research Center, Environmental Sciences, Environmental Engineering, Regional Planning, Zoology, Plant and Soil Sciences, Microbiology, Geology, Forestry and Wildlife Management, and Environmental Health.

The Environmental Health Program is planning a comprehensive program for health officials throughout the state. A private well water quality data bank would be useful to this program by aiding health, zoning and conservation commission officials in planning groundwater protection measures in their respective communities.

Many of the departments listed have been involved with the Massachusetts Geographical Information System (MassGIS). MassGIS is a computerized map overlay system in which "layers" of information such as land use, water quality, and soil type may be used to determine relative proximity information. Private wells and water quality information could be digitized to form a layer and used for research purposes. Exact well location would be necessary for the data to be most useful.

Private Sector Users

Discussion with a consulting environmental engineer suggests that a private well water quality data bank would be useful for the following purposes:

1. To aid in the search for new municipal water supplies by assessing the characteristics of specific aquifers.

2. To provide additional hydrogeologic data, such as depth-to-water table and data regarding well type, would increase the usefulness of the data bank.

3. To provide valuable background data for Environmental Impact Report studies which assess significant impacts of specific projects.

Any water quality data would be useful for these purposes, especially in rural areas where little is known about the water. It would be most useful if water

quality data and the information on the Water Well Completion Reports could be combined in one data bank.

The water treatment industry is interested in any data which would help them target their marketing efforts. The industry argues that statistical evidence of water quality characteristics would help create educated consumers less likely to fall prey to exaggerated promotional claims, for example about the need for water softening services.

Appropriate Software Technology

Software compatibility between commercial labs and the ORACLE data base system at DEQE is an important attribute of a central data bank. Table 5.6 indicates the range of software currently used by the twenty labs with computerized recordkeeping. Given the recent history of microcomputer adoption in the industry, it is likely that some of the sixteen labs who keep private well data on conventional data sheets will switch to computerized systems in the near future.

In most cases software currently used by the labs permits data to be converted into ASCII. By using some creative formatting, these data could be read into a central data bank. Since each software package is different, it would be necessary to analyze each system individually to program inputting of the data. One way to circumvent the problem of ASCII conversions would be to provide the labs with appropriate software. A specialized application compiled from conventional software, for example dBASE, could be distributed to the labs without the need for each lab to obtain site licensing for the software itself.

Only about half of computerized labs have a modem that could be used to transfer data directly to a data bank. An alternative way to transfer data is simply to mail computer disks.

Private Well Data Bank Systems in Other States

The following examples of private well information collection in other states are based upon interviews with water supply agencies in each state.

New Hampshire

Contact Person: Richard Schofield
New Hampshire Water Resources Board
Concord, NH

Contact Person: William Rice
Health and Human Services
Concord, NH

The New Hampshire system is divided between two sections of state government both of which are located in Concord. The Water Resources Board computerizes

well completion reports concerning well physical characteristics. The Health and Human Services Department deals with well water quality information.

The data base software used for Well Completion Reports is an rbase System 5 on an IBM and a Sperry computer. Data collected include: well depth, depth to bedrock, contractor name, location, date, use, type of well, casing details, yield, static water level, drillers log, screen details, and soil type. This information is considered public. Approximately 6,000 wells are dug and logged on the computer each year.

Wells are located by state personnel who go to the well sites to locate them on USGS quadrangle maps. The information is later digitized onto the GIS system using ARCINFO.

Users of this information include Waste Management Division, Office of Planning, USGS, and private consultants.

Well water quality data have been stored on a Hewlitt-Packard computer since 1984, using a custom designed data base system. Data are gathered from tests performed at the request of well owner. The owner is provided with a sample bottle and well water is brought to a state laboratory for analyses. Analyses may include any parameter (including radon), but only 10 parameters are usually tested for if no special problems are indicated. Owners must pay for the analyses that are supplemented by the state. Private well users include about 50% of the state population.

Users of the water quality information include the Department of Transportation (sodium concentrations only), Health Department, and Environmental Services.

New York

Contact Person: Anne Lemley
TXA 202 MVR Hall
Cornell University
Ithaca, NY

The County Extension Service of New York is just beginning to put a private well data collection system into use. Software for their IBM computer is under development. They will also be using the GIS system.

The cornerstone of the New York system is public education. The state provides seminars aimed at teaching well owners the dangers of contamination and the importance of well water testing. Owners are provided with sampling bottles at the seminars. Analyses are performed at commercial laboratories where release forms are provided to owners. County agents collect the data sheets or computer disks from the labs and mail out the information to the state for input into the central data bank. When contamination is found, the owners are notified. The seminars include alternatives for correcting contamination problems.

Records are kept on distances of wells from septic systems. Distances from other possible contaminating sources are not addressed in the computer

systems. The well information is used by university researchers, state and local governments, and the public. Public information includes well location by town and county only.

The state is particularly interested in encouraging testing, looking at well construction, agricultural contamination, septic system problems, and how and why pollution is spread. They estimate that 25% of the populace of upstate New York and 12% of Long Island are served by private wells.

Rhode Island

Contact Person: Brian Barrett
Department of Health
Providence, Rhode Island

The Rhode Island private well water collection system is run by the Department of Health. A Tandy 6000 multi-user computer is used to store data on a File-Pro Plus data base. Information has been collected by the state for 3,800 private wells. Data are currently generated from state lab tests. Eventually, they will utilize a system that will permit output from analytical equipment to be sent directly to a computerized data base.

The state does sampling of wells within a one-half mile radius of hazardous waste sites. As of 7/1/88, any information (including well location) collected by state testing is considered public. Prior to this date, data could be gathered only with the use of an owner-signed release form. The state typically tests for 23 volatile organic compounds for wells near landfill sites and other analyses for sites where other contamination is deemed possible by the Department of Environmental Management (DEM). Other data collected include well depth and lot plot.

In cases where contamination is determined, wells are retested. If contamination is confirmed, DEM sends a notice to the well owner. The state will help supply bottled water or a filtration system, and in some cases will aid in connecting a home to a public water supply if feasible.

Wisconsin

Contact Person: William Brock
Department of Natural Resources
Madison, Wisconsin

Wisconsin is dependent on groundwater for 70% of its population (Committee on Ground Water Quality Protection, 1986). Some 800,000 people rely on private well water sources.

The Division of Water Supply is in charge of the private well water quality data bank system. The systems used are the Groundwater Information Network and the Statistical Analysis System. These systems use information on water quality and other well characteristics such as depth to water, casing depth, and water bearing formation.

State field staff collect private well water samples that are sent to the state Laboratory of Hygiene. Test results are sent electronically to the central data bank in Madison. The state requires testing only for new wells and bacteria is the only obligatory test. Some 20,000 to 30,000 wells are tested for bacteria each year. The state will additionally analyze for nitrate if the owner desires, at the cost of $7.00 for the two analyses. The state also tests about 200 wells per year for pesticides, VOC's and inorganics. Test results from samples taken by the state are considered to be public information.

When contamination has been determined, the well owner is informed and a suggestion is made for a retest. The state offers free technical assistance in solving contamination problems. If a new well is needed, the state will supply up to 80% of the cost. Contamination data are used to predict problems for wells in close proximity to polluted wells.

Wisconsin produces fliers and magazines addressing water quality issues, and uses other means to educate the public of the importance of well testing.

Some of the users of the information include the Division of Water Supply, Department of Natural Resources, and the Department of Agriculture, Trade and Consumer Protection.

V. SUMMARY AND CONCLUSIONS

Summary of Survey Findings

Analysis of survey results, interviews and the literature review suggests that it would be feasible and relatively inexpensive to create a private well water quality data bank in Massachusetts based on data from certified environmental laboratories. To highlight relevant findings, a summary of survey results follows, along with a discussion of data bank options.

1. There are 55 commercial labs in the state, of which 16 do not perform tests on private wells, and 3 declined to supply information. The remaining 36 labs reported that they perform private well water tests. Twenty of the 36 labs keep data records in computerized form.

2. According the estimates of laboratory managers, a total of 22,808 private wells were tested by commercial labs between March 1, 1988 and February 28, 1989.

3. Labs with computerized data tested 13,150 private wells, or 58% of the total. If the largest private well water testing lab in the state (5000 wells per year) became computerized, then about 80% of the data would potentially be accessible without manual data entry.

4. Most labs (26 of 36) collect no information about physical characteristics of wells, or proximity to possible sources of contamination.

5. Thirty-two of 36 labs, and 17 of 20 computerized labs, keep no information about why a well is being tested.

6. All 20 labs with computerized data currently use different data base management systems.

7. Of 20 computerized labs, 13 are aware that they have the capability to convert data into ASCII format so that data could be easily transferred. Others presumably do also, but did not know.

8. Half of computerized labs have computer modems.

9. Twenty-six of 36 labs, including 16 of 20 computerized labs, indicated they might be willing to provide data to a central data bank.

10. Well locations are identified by address of well owner and/or well location by 27 of 35 labs responding, and 15 of 20 computerized labs.

11. Without waivers of confidentiality, only 7 of 36 labs, and 4 of 20 computerized labs, would provide more specific well location information than town name. In fact, 14 of 36 labs (7 of 20 computerized labs) said they would not supply any location information without a waiver.

12. Computerized labs expressed a wide range of estimates for the time needed to provide existing data. The range was from 15 minutes to more than 40 hours per week.

13. Thirty-one of 36 labs, and 19 of 20 computerized labs, answered "yes" or "possibly" to the idea of asking well owners to sign release forms.

14. Thirty-four of 36 labs, and all 20 computerized labs, said they are willing or might be willing to provide incoming private well water quality data to a central data bank in the future.

15. Most labs preferred to report on a monthly or quarterly basis.

16. Fifteen of 20 computerized labs estimated that 1 hour per week or less would be needed by an employee to provide data to a central data bank on a regular basis.

17. Fifteen of 32 labs and 10 of 18 computerized labs would be willing to provide information only if compensation were arranged.

Options for Creating a Data Bank

Survey results suggest several possible approaches to creating a data bank. The two general categories of data which might be obtained are: 1) existing data, based on tests which have already been performed by the labs, and 2) incoming data, from tests which will be performed in the future. The problems associated with existing and incoming data are quite different, so the two will be discussed separately. It would of course be possible to include data from both sources in the same data base.

Case 1. Existing Data

For data already on file, commercial labs have not asked well owners to sign waivers of confidentiality. This constrains the willingness of the labs to contribute existing data to a central data bank. Although most labs were willing to supply existing data, or at least willing to discuss the idea, very few are comfortable including exact well locations. Most labs would be willing to identify at least the town in which a well is located. However, one third of lab managers were not willing to supply any location data, even town name, without a confidentiality waiver. It is probably not feasible to obtain owner releases retroactively for tests which have already been performed.

Some tests may have been requested by well owners or well drillers in order to comply with Board of Health requirements. These test results might legitimately be regarded as public information. However, laboratory records generally do not include information about why tests are being requested, so there is no obvious way to identify these records in order to obtain release of complete well location information. In the future, a standard waiver form could include a question to ascertain whether tests are being done to comply with any state law or Board of Health regulation.

It is feasible to build a data base of existing water quality data, as long as wells are identified only by town rather than street address. Survey

responses suggest that about one-half of all labs would contribute voluntarily to a data base of this kind.

The maximum age of records to be included would need to be decided. Older data are intrinsically of less interest than more recent data. Moreover, most currently certified labs in Massachusetts have not been in business for more than a few years. It is therefore reasonable to think of requesting records for the past three years only. The total number of records which would be available from labs willing to participate would be between 20,000 and 50,000. Such a data pool would be of interest to many potential users who have been contacted. However, its usefulness would clearly be reduced for many purposes by the absence of street addresses.

Three primary types of direct costs would be associated with collecting existing data: 1) programmer time to set up the data base system, 2) data entry for 20,000 to 50,000 records from twenty to forty different laboratories, and 3) possible compensation to laboratories to identify and copy private well records, deleting owner names and addresses.

Programmer time involves analysis of current and future needs to design an appropriate data base format, consultation with state computer data base personnel, and training of a data entry typist. Data entry time should be conservatively estimated since twenty to forty different styles of records might have to be read into the system and error checking would presumably be performed by double entry procedures. Lab managers' estimates of the speed with which an employee could transfer town-identified data ranged from less than one record per hour to 100 records per hour. The average figure, about 27 records per hour, is assumed below.

The basic direct costs for compiling existing water quality data are therefore as follows:

	Based on 20,000 Records	Based on 50,000 Records
1) programmer time (1 month)	$ 3,000	$ 3,000
2) data entry (# records / 60 records per hour x $10/hour x 2 for error check)	6,666	16,666
3) compensation to labs (# records / 27 records per hour x $10/hour)	7,407	18,518
TOTAL ONE TIME COSTS	$17,073	$38,184

Some labs have computerized data for all or part of the past three years. Direct computer transfer of some data might be possible. This may not offer a significant cost reduction, however, since each of the twenty currently computerized labs uses a different combination of hardware and software. If some data were transferred by disk or modem, the time required for data entry would be reduced, while programming time would be increased; the effect on compensation required is uncertain. Thus we consider the bounds of best estimate of the direct costs of creating a data base with three years of

existing data to be $17,000 to $38,000. In addition there would be administrative costs for oversight and for minor supplies and materials.

Case 2. Incoming Data

If a data base is constructed from incoming data, its usefulness can be greatly enhanced by including specific well locations along with water quality test results. The client confidentiality concerns of many lab managers could be satisfied by asking well owners to sign release forms when water samples are submitted. Some owners may choose not to sign; however, the value of complete well location information outweighs any such loss in the number of observations. For many potential data users in both academic research and the public sector, exact well location is a crucial aspect of water quality data. Because private well testing in Massachusetts is performed by privately owned laboratories, the use of waiver forms is central to the establishment of an ongoing private well water quality data base.

The volume of new data which might be available annually can be estimated from survey responses. Thirteen lab managers indicated they would both provide data and use waiver forms; these labs performed more than 9,000 tests in the past year. Another 18 labs answered "possibly" to these questions. If this group also participated, there would be a potential total of 13,000 test results contributed per year. Nearly 10,000 of these records are maintained in computerized form. The total number of private well tests performed by all labs was about 20,000 in one year. Depending on the incentives offered to labs to participate, and depending on whether all data or only computerized data are included, the data base could acquire between 10,000 and 20,000 new records each year. Of course, not all individuals will sign the waiver, so the number of new records would be reduced by the proportion refusing to sign. On the other hand, the number of well tests requested and the fraction of labs with computers are increasing, so the number of records potentially available is larger each year.

One way of handling incoming data would be data entry from data sheets, as in Case 1, with labs responsible only for duplicating the sheets. Once a data base was established, the only major direct annual cost would be data entry for 10,000 to 20,000 records; this should amount to less than $7,000 per year, based on assumptions made previously. If the number of records from participating labs increased, annual data entry costs would increase proportionally.

However, since most labs now keep computerized records, it should instead be possible to devise a system of direct transfer of computer data, which could be updated each year at virtually no cost. The survey revealed great diversity among the computer systems employed by private environmental laboratories, both in hardware and software. Computerized data could however be downloaded to ASCII format, in which case relatively little programming should be required to read data into the central data base. It is likely that nearly all of the systems used by the labs are capable of ASCII conversion, even if the survey respondents were unaware of the possibility.

For a system which is to be ongoing, direct transfer of computerized data will be more efficient than annual data entry. Transfer of computer data in

ASCII format could be supplemented with manual entry from data sheets for the remaining labs if desired. The major costs of such a system would be: 1) programming to set up the data base initially and to set up systems to read ASCII data from the various labs into the data base, and 2) data entry for non-computerized records or those which for any reason cannot be read directly into the data base in ASCII format.

Estimated major direct costs associated with creating a data base for incoming private well data are the following:

One-time costs:

1) programmer time to create data base (1 month)	$ 3,000
2) programmer time to train lab personnel in transferring data through ASCII format including some site visits (2 months)	6,000
3) programmer time to analyze ASCII data to read into centralized system (2 months)	6,000
TOTAL ONE TIME COSTS	$15,000

Annual operating costs:

Labs with Computerized ASCII Transferable Data	
1) update programs for inputting data for labs with new computer systems	Negligible
Remaining Labs (OPTIONAL)	
1) data entry of annual records	$ 2,000
TOTAL ANNUAL COSTS	$ 2,000

The $2,000 figure for annual data entry assumes that 2/7 of labs would not be computerized or would have records which are not easily interpreted in ASCII format. As before, no effort has been made to include overhead, computer facilities for the data bank, or the cost of supervisory personnel.

It is assumed that with the use of waiver forms, compensation to labs would not be necessary. For existing data, the time required to make records available is primarily the time involved in deleting confidential information. The amount of time required for computerized labs to download quarterly data to ASCII is only a few minutes. The same is true for noncomputerized labs to duplicate quarterly data sheets.

A combined system for existing and incoming data would be less costly than the sum of the individual estimates given above. In particular, programmer time to set up a system would not have to be duplicated, resulting in a reduction of $3,000. In addition, systems devised to interpret ASCII records from computerized labs could be used for both new and existing computerized

records. This could result in some reduction in data entry costs for existing data, at least in those cases where confidential information can be easily deleted electronically while retaining town name. Total direct costs to set up a data base incorporating existing data for the most recent three years plus incoming data are therefore estimated to be between $29,000 and $50,000, depending on the laboratory participation rate; administrative costs would be additional.

A logical candidate for data base software appears to be dBASE, which DEQE has already adopted as one of its standards. About two thirds of computerized labs currently have hardware capable of supporting dBASE.

Comments and Conclusions

The four states surveyed as part of this study devote considerable resources to testing and monitoring private well water quality. They run public education programs to encourage private well owners to have water tested. The tests in most cases are performed in state run laboratories, where the cost to clients is subsidized. Client confidentiality appears to be of less concern in such a setting, making it relatively easy to compile valuable water quality data.

In Massachusetts, private well water testing is generally performed by state-certified commercial laboratories rather than state labs. In order to obtain private well data it is therefore necessary to establish working relationships with the private labs. An essential ingredient is the use of uniform client confidentiality waiver forms to be signed when samples are brought in for testing. The waiver form should ask permission to include all data except the owner's identity in a state data base, the purpose of which is to oversee the quality of private wells across the Commonwealth. Presumably the use of release forms could be required as part of state certification. In any case most labs have expressed willingness to use them voluntarily.

In addition to being asked to release data, clients should be asked whether water tests are being performed to comply with local Board of Health requirements, for example in conjunction with a building permit. If so, the data might be considered public information even without the well owner's signature on the waiver statement. Because samples from new wells are often brought in by well drillers rather than well owners, this second part of the waiver might often be the relevant part.

Flagging new wells in this way would also make it possible to match up water quality test results with corresponding Water Well Completion Reports, which are filed with the Department of Environmental Management. A number of potential data base users have commented that if the water quality data base is established, it should be merged with these data on the physical characteristics of new wells. Water quality investigators often wish to know well physical characteristics together with well location and water quality test results. Since Boards of Health require water quality testing for new house sites, commercial labs perform water quality tests for many of the same wells described in the Water Well Completion Reports. The data in the Water Well Completion Reports are currently not computerized and therefore not

readily available. Cooperation between DEQE and DEM could result in construction of a more comprehensive data base.

It might be desirable in the future to encourage labs to adopt the data base software and format used in the central data bank, so that regular transfer of records to the state system could be accomplished directly, without conversion through ASCII. A number of labs have expressed interest in receiving software and training for such a system. A compiled software application could be developed and distributed to avoid the need to purchase software licenses for each laboratory.

It is worth noting that, once established, the data base system could be expanded to include water quality data from sources other than commercial labs. Several state agencies, including DPH, DFA and DEQE divisions, and several University of Massachusetts departments and programs, have conducted water quality testing, and may wish to enter these data records into the data base. In addition, private and public well water quality data could be entered into a Geographical Information System (GIS) format, to facilitate analysis of water quality patterns across Massachusetts.

Interviews with potential users suggest that there is considerable demand for much more extensive private well water quality information than currently exists. This need is felt particularly in the research, public policy and public health fields. There is interest even in town level information, such as that which would be available for existing well test records. The usefulness of records with complete well location information would be of course even greater.

One advantage of a combined data base, which is constructed initially of town level data already available, and later adds incoming data with full well locations, is that the former could be obtained within a matter of months. Those labs which have already expressed willingness to participate would simply have to be contacted, and presumably offered compensation as most have requested. In contrast, the establishment of an ongoing data bank would most likely require several years. A legally acceptable confidentiality waiver form would have to be devised by the Commonwealth and adopted by a significant number of labs before data would begin to become available. Many potential data users feel the need for better private well information as soon as possible.

BIBLIOGRAPHY

Baker, J. H. Sulfate Retention by Soils of Central New England. Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts, Pub. No. 151, 1986, 32 pp.

Committee on Ground Water Quality Protection. Ground Water Quality Protection, State and Local Strategies. National Academy Press, Washington, D.C., 1986, 309 pp.

DEM. Massachusetts Public Water Supply 1980 Service Population. Department of Environmental Management, Division of Water Resources, Publication No. 13626-18-500-5-84-C.R., April, 1984, 17 pp.

DEQE. Drinking Water Regulations. Department of Environmental Quality Engineering, The Commonwealth of Massachusetts, No. 012089, June, 1988.

Driscoll, F. G. Groundwater and Wells. 2nd Edition, Johnson Division, St. Paul, Minnesota, 1986, 1089 pp.

EOEA. Massachusetts Private Water Supply Policy Statement. Massachusetts Water Resources Commission, Executive Office of Environmental Affairs, Boston, Massachusetts, Pub. No. 14966-11-1000-8-11-87 cr, February, 1987, 9 pp.

Frimpter, M. H. Massachusetts Ground-water Quality. National Water Summary 1986 - Ground-water Quality: Massachusetts, USGS Water-Supply Paper 2325, 1987, 297 - 304.

Gibson, U. P., and R. D. Singer. Water Well Manual. Premier Press, Berkeley, CA, 1971, 156 pp.

Godfrey, P. J., A. Ruby III, O. T. Zajicek, S. J. DeFrancesco, M. Sutherland, J. K. Edzwald, F. Taylor. Design of a Drinking Water Quality Monitoring Program. Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts, Pub. No. 154, 111 pp.

Heeley, R. W., J. A. Maloney, E. Storms. Replacement of Groundwater Supplies Contaminated with Pesticides in Whately and Granby, Massachusetts. In: Proceedings of the Third Annual Eastern Regional Ground Water Conference July 28 - 30, Springfield, Massachusetts, National Well Water Association, Dublin, Ohio, 1986, pp. 543 - 568.

Kaynor, E. R. Municipal Groundwater contamination in Massachusetts: The Case for Wellhead Protection in Humid Regions. Water Resources Research Center, University of Massachusetts, Amherst, Massachusetts, Publication No. 158, May, 1988, 209 pp.

Massachusetts Bureau of Solid Waste Disposal. Active Landfill Report. Department of Environmental Management, 1985.

Patrick, R., E. Ford, J. Quarles. Groundwater Contamination in the United States. Second Edition, University of Pennsylvania Press, Philadelphia, PA, 513 pp.

Persky, J. H. The Relation of Ground-water Quality to Housing Density, Cape Cod, Massachusetts. United States Geological Survey, Water-Resources Investigations Report 86-4093, Boston, MA, 28 pp.

Scarano, L. J. The Massachusetts Aldicarb Well Water Survey 1983 - 1985. In: Proceedings of the Third Annual Eastern Regional Ground Water Conference July 28 - 30, Springfield, Massachusetts, National Well Water Association, Dublin, Ohio, 1986, pp. 261 - 276.

Stone and Webster. Connecticut River Valley Pesticide Study. Stone and Webster Engineering Corporation, Boston, Massachusetts, March, 1988.

USEPA. Agricultural Chemicals in Groundwater: Proposed Pesticide Strategy. United States Environmental Protection Agency, Office of Pesticides and Toxic Substances, Washington D.C., December, 1987, 150 pp.

Weintraub, J. W. Private Well Contamination in Massachusetts: Sources, Responses, Needs. Special Legislative Commission on Water, April, 1988, 73 pp.

APPENDIX A

Summary of Preliminary Interviews with Selected Commercial Environmental Laboratories

Lab Personnel: Walter Jeronczyk (owner) and Allen Murphy (director)

Firm: J and W Laboratory
Northfield Road
Millers Falls, MA 01349

Telephone: 413-659-3732

Date: February 1, 1989

Topic: Discussion of problems with private well regulations

The J and W lab owner felt that there were numerous problems concerning water quality in private wells being constructed in Massachusetts. These problems center around better consumer protection. He felt that many water quality problems stem from inadequate construction and result from a lack of qualified people that run the well digging rigs. Although the well diggers that sign well completion reports must be certified, their workers do not. Furthermore, well installers do not need to be certified at all.

The Well Completion Reports are not specific enough according to the J and W personnel. Although the length of well casings must be included in the reports, there is no provision for reporting whether a casing is bored into bedrock or merely reaches the upper surface of the rock. This is an important consideration concerning possible coliform contamination. Also concern was expressed that although the reports provide check spaces pertaining to whether biological or chemical tests were performed, there is no provision for reporting any generated data, and no requirement as to which tests if any should be submitted with the reports.

Well water samples are sometimes brought to the J and W lab by the well drillers themselves which could allow analyses of misidentified water samples by a well digger.

Mr. Murphy, the lab director, indicated that water tests for new wells were performed on water taken directly from the wells rather than the faucet (samples taken before construction of a house has been initiated) where additional contamination could be caused by the piping. Additionally, he claimed that chlorine added to some wells prior to testing to reduce coliform may not solve potential future water quality problems.

Lab Director: Peter Law

Firm: Tighe and Bond Inc.
50 Payson Avenue
Easthampton, MA 01027

Telephone: 413-527-5600

Date: February 15, 1989

Topic: Commentary on creation of a private well data bank

Tighe and Bond has a well-equipped laboratory that is certified for all parameters pertaining to drinking water including pesticides, trihalomethanes, and volatile organics. The lab instrumentation includes: 2 AA's (atomic absorption spectrophotometer), computerized gas chromatographs, GCM's, light spectrophotometry, digestion apparatus, and basic equipment used in typical drinking water testing. In 1986, EPA published some 80 new drinking water limits for organic contaminants. Mr. Law pointed out that many of these still have not become official.

Tighe and Bond does not record any information about well characteristics or location with respect to possible sources of contamination.

Data have been recorded for the past year on a personal computer data base software package, that can be converted to ASCII files and transferred to other data bases. Their computer does not have a modem that would allow direct transference of data from their computer to an external source. All data prior to 1988 are stored on data sheets. Data greater than seven years old are discarded.

Mr. Law felt that Tighe and Bond would probably be willing to participate in contributing data to a data bank if specific locations of wells were not identified. He was uncomfortable with identifying wells by longitude and latitude since addresses could be identified with the use of maps.

Mr. Law was also concerned about time involved in providing data for the state. He believes a compensation system would need to be worked out. He emphasized that, even with adequate compensation, during the summer months their lab and other labs become extremely busy.

One way to overcome the confidentiality problem, according to Mr. Law, would be to provide "letters of release" to be signed by owners for use of their well water data. This technique was used by DEQE in the mid-1980's when private wells were being analyzed for pesticides by Tighe and Bond. Mr. Law said that DEQE mailed the forms to homeowners. Tighe and Bond was notified by DEQE of all positive responses to the forms, and records of previous analyses for the associated wells were then provided to DEQE.

There were no community drinking water quality task groups or committees that Mr. Law was aware of.

Lab Director: Allen Murphy

Firm: J & W Laboratory
Northfield Road
Millers Falls, MA 01349

Telephone: 413-659-3732

Date: February 16, 1989

Topic: Commentary on creation of a private well data bank

Private well water analyses that are typically performed by J & W include: coliform, pH, alkalinity, chloride, color, hardness, iron, manganese, nitrate, and turbidity. They have recently been performing metal analyses as well (using an atomic absorption spectrophotometer). The lab is certified for the analyses they perform except the metals, for which they are presently awaiting certification. They do not have analytical capabilities for pesticides or other organic chemicals, and therefore send these samples out to other labs.

Since the company began performing analyses in 1985, all data have been stored on an Apple IIe data base system. This information can be downloaded to an ASCII file, and utilized as input into another data base system (e.g. ORACLE or dbase III plus). Mr. Murphy expressed an interest in contributing J & W data to a state data base system, assuming some arrangement could be made for compensation. However, their computer does not have a modem, necessitating information transference to DEQE via mailing data stored on diskettes.

Water samples are usually delivered to J & W by the well owners. Mr. Murphy recommends that people collect samples in containers provided by the lab in order to assure sample purity. Results of the tests (including water quality standards) are given to the owners exclusively. Any organization, including the local board of health, that wishes to obtain the results is referred to the well owners. Mr. Murphy thought that data might be provided to a state data base if names and addresses were omitted. They would be willing to request owner signatures on a standardized DEQE release form, so that future data could be provided with associated addresses.

J & W does receive information concerning whether a sample was taken from a shallow or deep well. This is the only well information that they record besides results of the analyses.

Mr. Murphy was unaware of any community water quality committee.

One problem that Mr. Murphy mentioned was the fact that lab certification for a given water quality test may take 6 to 8 months to obtain. In the meantime uncertified analyses (i.e. metal analyses) may be performed at the owner's request and recorded on the J & W computer. If one looks at the data base at some future point, there will be no way to determine which analyses were performed prior or subsequent to certification.

With respect to the upcoming survey, Mr. Murphy believes that the labs should be given two weeks to reply. He felt that a period of three weeks or more would allow people to procrastinate or forget about filling out the survey.

Lab Director: William Enser

Firm: Berkshire Enviro-Labs, Inc.
P. O. Box 113
Lee, MA 01238

Telephone: 413-545-2496

Data: February 21, 1989

Topic: Commentary on creation of a private well data bank

Berkshire Enviro-Labs is a small water quality lab that performs the usual array of drinking water tests including: coliform, pH, alkalinity, chloride, fluoride, hardness, calcium, iron, manganese, sodium sulfate, ammonia, nitrite, and nitrate. Sampling kits and instructions are provided by the lab to well owners in order to avoid contamination from unclean bottles. They use EPA approved methods for their analyses and are certified for all of the parameters listed. Analyses for other metals and organic contaminants are sent out to other labs that are equipped and certified to perform these tests.

All data are recorded on standardized forms put out by the company and are stored in record files dating back at least ten years. This data does not include physical characteristics about the well or proximity of the well to possible contamination. None of their data are kept on computers presently, but the lab may be converting to a computerized system in the near future.

Mr. William Enser, the lab director, stated that private well water test results are sent exclusively to the respective owners. He would be willing to release data by town to a central data base system, provided addresses and names were deleted. Supplying old records from his files would be very time consuming, since they are not computerized; compensation would be necessary. He had no problem with asking well owners if they would be willing to sign a waiver form to allow the state to use data associated with addresses. There are cases Mr. Enser was aware of where communities have gotten access to private data by obtaining a waiver from a private well owner. However, he knew of no drinking water quality task committees.

Mr. Enser suggested that the state develop a computerized data base system that would be distributed to all the private labs in the state. This system would allow lab personnel to transfer private well data to computer diskettes, that could be supplied by the state, and mailed to DEQE each month. In this way DEQE would be able to build a data base from private data while providing little compensation, since very little additional time would be needed by the labs to transfer the data. Since all of the labs would be using the same software, there would be no problem with downloading data from different data base systems in order to transfer information to the DEQE data base system.

Lab Director: Ronald Leblanc

Firm: Lycott Environ. Research
600 Charlton Street
Southbridge, MA 01550

Telephone: 508-765-0101

Date: March 2, 1989

Topic: Commentary on creation of a private well data bank

Lycott, located in Southbridge, MA, is certified to perform the full range of drinking water tests for bacteria, general parameters (e g. pH, color, and turbidity), metals, volatile organics and pesticides. The lab director, Ron Leblanc, stated that in many cases private wells were tested only for bacteria, but banks in the area usually require a battery of tests including: bacteria, odor, color, conductivity, turbidity, pH, hardness, sodium, iron, manganese, chloride, nitrate, nitrite, and tannins.

Lycott has been performing water tests for more that ten years. About three years ago they computerized their data using data base software called R-base 5000. This data is archived on floppy disks after six months.

Water quality reports are sent only to the party that request the analyses (e.g. well owner, board of health, or bank). These reports do not contain any information about the well physical characteristics, soil type, or relation to sources of pollution. Mr. Leblanc would be willing to release data to state data bank with town identification only. At present each well location address is identified in one formatted computer language field, necessitating a modification of the software in order that street addresses could not be revealed. This would require compensation to the lab in order to hire a computer programmer. Complete addresses could be provided if release forms were signed by the owner. The computer is not equipped with a modem, but data could be transferred by mailing disks to the state on a periodic basis. Mr. Leblanc believes their system can download data to ASCII files to allow the information to be loaded into a state computer data base system. Mr. Leblanc believes Lycott would not be willing to make use of a state designed data base software package.

Mr. Leblanc was unaware of any drinking water committees concerning private wells.

There were two additional concerns that Mr. Leblanc expressed with respect to this study and private wells in general. First, their lab is very busy and would not be able to allocate too much time to provide information to the state. Secondly, he has found private well owners and local Boards of Health to be very uninformed concerning which analyses are appropriate for their wells and the appropriate corrective measures for wells that are found to be contaminated. He believes a public educational system would be beneficial.

APPENDIX B

Survey Questionnaire

Survey of Private Well Water Quality Data of Massachusetts Commercial Certified Environmental Laboratories

The following survey is part of a DEQE funded project to determine the feasibility of creating a private well water quality data bank in the interest of protecting the public health of Massachusetts residents. Your responses would be greatly appreciated.

Please Return Survey by March 31, 1989

Please circle or write in responses where appropriate.

1. Approximately how many different private wells has your lab tested in the past year (March 1, 1988 - February 28,1989)?

    1. ESTIMATE_____

2. About what percentage of wells were tested more than once?

    1. ESTIMATE_____

3. Does your lab perform any uncertified analyses?

    1. YES
    2. NO

    If so, can these records that are computerized be distinguished from those that were certified tests?

    1. YES
    2. NO

4. Do your data include any information about physical characteristics of the wells or proximity to possible sources of contamination? (circle any that apply)

    1. WELL DEPTH
    2. SOIL TYPE
    3. POSSIBLE CONTAMINATION SOURCE (e.g. SEPTIC SYSTEM, LANDFILL)
    4. DISTANCE FROM CONTAMINATION SOURCE
    5. INFORMATION UNAVAILABLE
    6. OTHER (SPECIFY) _____

5. Do your data identify why a well is being tested?

    1. YES
    2. NO

6. Do you know of any local groups that are gathering private well water quality information?

PLEASE LIST: 1. _____

2. _____

7. Are private well water data stored on computer disks or data sheets? (please specify dates)

1. DATA SHEETS 19____ to 19___

2. COMPUTER DISKS 19____ to 19____

8. If data are stored on computer disks , what format do you use?

1. dBASE II
2. dBASE III PLUS
3. OTHER DATA BASE SOFTWARE (SPECIFY)_____
4. DON'T KNOW
5. OTHER (SPECIFY)_____

9. Can computer data be converted/downloaded into an ASCII format?

1. YES
2. NO
3. UNSURE

10. Does your computer have a modem?

1. YES
2. NO
3. UNSURE

There are two types of data that might be useful in learning more about private well water quality: existing data from previous analyses, and data which will be incoming from future tests. The next three questions refer to existing data records from analyses which were performed by your lab.

11. Might you be willing to provide existing private well water quality data to a state data bank?

1. YES
2. NO

12. In what manner are well locations identified?

1. ADDRESS OF WELL LOCATION
2. ADDRESS OF OWNER
3. BOTH

13. Along with test results, what sort of well location information would you be willing to release without a waiver from the well owner?

1. STREET ADDRESS
2. STREET NAME ONLY
3. APPROXIMATE LONGITUDE AND LATITUDE
4. TOWN NAME ONLY
5. NONE
6. OTHER (SPECIFY) _____

14. How much time would you estimate might be needed for an employee to provide existing computerized data to the state with the well identified in the manner that you indicated in the question above?

1. 15 MINUTES
2. 1 HOUR
3. 5 HOURS
4. 10 HOURS
5. 20 HOURS
6. 40 HOURS
7. OTHER (SPECIFY)_____

The remaining questions refer to data records from analyses that will be performed by your lab in the future.

15. Would you be willing to ask well owners to sign a release form so that complete records for future data could be contributed to a state data bank?

1. YES
2. NO
3. POSSIBLY

16. Would you be willing to provide new private well water quality data to a data bank in the future?

1. YES
2. NO
3. POSSIBLY

If your answer is yes or possibly, what reporting frequency would be best?

1. MONTHLY
2. QUARTERLY
3. SEMIANNUALLY
4. ANNUALLY

17. How much time would you estimate would be needed by an employee to provide incoming data on a regular basis?

1. PRACTICALLY NONE
2. 1 HOUR/MONTH
3. 1 HOUR/WEEK
4. 5 HOURS/WEEK
5. 10 HOURS/WEEK
6. OTHER (SPECIFY)_____

18. Would you be willing to supply data only if a compensation rate per hour were arranged?

1. YES
2. NO

Thank you for your time and consideration.

APPENDIX C

Compilation of Survey Responses from Commercial Certified Environmental Laboratories

Compilation of Survey Responses from Commercial Certified Environmental Laboratories

LABORATORY	Q1	Q2	Q3	Q3A	Q4				Q5		Q7				Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q16A	Q17	Q18
					1	2	3	4	5		Sheets		Computer													
AGTL	350	-	2	-	-	-	-	-	1	2	79	89	-	-	-	-	-	2	1	5	-	1	1	2	3	2
Alpha Analytical	15	30.0	1	1	-	-	-	-	1	2	-	-	85	89	Word Star	1	1	1	2	4	6	1	1	2	3	2
Aqua Test	550	1.5	-	-	1	-	-	-	-	2	87	89	-	-	-	-	-	1	3	5	-	1	3	3	-	1
Barnstable County Lab	1500	1.5	2	-	1	-	1	1	-	1	76	88	89	89	dBase III	1	-	1	3	1	-	1	1	3	3	2
Berkshire Enviro-Labs	875	40.0	2	-	-	-	-	-	1	2	76	89	-	-	-	-	-	1	3	-	-	1	1	1	3	-
Biomarine Research Corp.	250	5.0	1	1	1	-	1	-	-	2	82	88	89	89	Mac. Microsoft Excel	3	1	1	3	2	4	1	1	3	3	1
Briggs Associates	30	2.0	2	-	-	-	-	-	1	2	85	88	89	89	Mac. Writenow W. P.	2	2	1	1	4	3	1	1	1	1	2
Cambridge Analytical	10	0.0	1	1	-	-	-	-	-	1	88	88	89	89	Cambr. Anal. Custom	1	1	1	3	5	5	3	1	1	3	-
Camp, Dresser & McKee	10	0.0	1	1	-	-	-	-	1	2	69	83	84	89	Digital Vax dBase	1	1	2	2	5	7	1	3	3	3	2
Certified Engineering	100	0.0	2	-	-	-	-	-	1	2	-	-	85	89	Cert. Eng. Custom	2	1	1	2	5	3	3	3	3	1	1
Clean Harbors (Bedford)	10	0.0	2	-	-	-	-	-	1	2	84	89	-	-	-	-	-	2	2	4	-	1	3	2	1	2
Clean Harbors (Braintree)	5	0.0	1	2	-	-	-	-	1	2	83	89	-	-	-	-	-	2	2	5	-	1	1	2	2	2
Con-Test Lab	100	1.0	1	-	-	-	-	-	1	2	87	89	-	-	-	-	-	1	2	-	-	3	3	2	3	2
ERT	100	50.0	1	1	-	-	-	-	1	2	75	80	81	89	Mass Spec/Perk. Elm.	3	1	2	3	5	-	3	3	2	3	1
ESA	100	0.0	2	-	-	-	-	-	1	2	-	-	72	89	Prime Custom	1	2	1	3	4	4	3	3	2	3	1
Environ. Sciences Lab	88	5.0	1	-	-	-	-	-	1	1	83	88	89	89	PCF & PC File Plus	1	1	1	1	4	7	1	1	1	3	2
Envirotech Labs	1300	2.0	1	1	1	-	-	-	-	1	86	89	-	-	-	-	-	1	3	1	-	1	1	1	4	2
GHR	240	10.0	1	1	-	-	-	-	1	2	75	89	-	-	-	-	-	1	3	4	-	1	1	2	3	2
Groundwater Analytical	12	0.0	2	-	-	-	-	-	1	2	87	88	89	89	HP Chem. Station	1	2	1	2	5	-	3	3	4	6	1
Hydrosample	28	5.0	2	-	-	-	-	-	1	2	87	89	-	-	-	-	-	1	3	5	-	3	3	2	3	2
J & W Laboratory	600	5.0	1	1	-	-	-	-	1	2	-	-	85	89	Apple, IIE dBase	1	2	1	3	2	3	1	1	2	3	1
Lenox Inst. for Research	70	4.0	1	1	-	-	-	-	1	2	-	-	83	89	Word Pro-4 (W.P)	1	2	1	3	1	1	1	1	4	2	2
Lycott Environ. Research	4000	10.0	1	1	-	-	-	-	1	2	81	86	87	89	R-base	1	2	1	3	4	6	1	1	2	4	1
Millipore Corporartion	15	3.0	2	-	-	-	-	-	1	2	-	99	87	89	RSI	3	1	1	3	4	3	3	3	2	3	2
Oliveira Environmental Labs	5000	25.0	2	-	1	-	-	-	-	2	62	89	-	-	-	-	-	2	3	5	-	2	3	1	4	2
Reitzel Associates	200	10.0	2	-	1	-	1	1	-	2	68	89	-	-	-	-	-	1	3	2	-	3	1	-	4	1
Revet	50	90.0	2	-	-	-	-	-	1	2	-	-	85	89	HP Extrel	2	2	2	3	5	-	3	3	2	4	1
SP Engineering	50	10.0	1	2	-	-	-	-	1	2	80	89	-	-	-	-	-	1	3	4	-	3	3	1	2	1
Standards Methods Lab	300	20.0	2	-	1	-	-	-	-	2	78	89	-	-	-	-	-	1	3	2	-	3	1	4	4	1
Stevens Water Analysis	200	25.0	1	1	-	-	-	-	1	2	80	89	-	-	-	-	-	1	3	-	-	2	3	-	-	1
Thorstensen Labs, Inc.	3500	20.0	2	-	-	-	-	-	1	2	-	-	88	89	Tandy Custom	1	2	2	2	5	-	2	3	2	4	1
Tighe & Bond Lab	200	10.0	2	-	-	-	-	-	1	2	-	-	88	89	J-Lang. dBase	1	2	1	3	6	7	3	3	2	3	-
Toxicon Corp.	400	-	1	1	-	-	-	-	-	2	86	89	-	-	-	-	-	2	3	5	-	2	2	-	-	2
Water Control Lab	1000	15.0	1	1	-	-	-	-	1	2	82	85	86	89	Gemini Lab Info	1	1	1	3	4	7	3	3	1	4	2
Waterworks Lab	1500	10.0	2	-	-	-	-	-	1	2	83	88	89	89	Custom	3	2	1	3	4	-	3	3	1	3	1
Whitman & Howard Lab	50	0.0	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	5	-	2	2	-	-	9

Designation of Survey Question (see key on following pages)

KEY TO QUESTIONNAIRE RESPONSES

Question	Response	Code	Interpretation
1	Q1		Number of wells tested in past year
2	Q2		Percent of wells tested more than once
3			Uncertified analyses performed by lab
	Q3	1	Yes
		2	No
	Q3A		Uncertified test records can be identified
		1	Yes
		2	No
4	Q4-1		Data include well depth information
		1	Yes
		2	No
	Q4-2		Data include soil type
		1	Yes
		2	No
	Q4-3		Data include possible contamination source
		1	Yes
		2	No
	Q4-4		Data include distance from possible cont. source
		1	Yes
		2	No
	Q4-5		Information in Q1-4 through Q4-5 unavailable
		1	Yes
		2	No
5	Q5		Data identify why well is being tested
		1	Yes
		2	No
6 (Question not included)			
7	Q7 (Sheets)		Beginning date for data stored on data sheets
	Q7 (Sheets)		Ending date for data stored on data sheets
	Q7 (Computer)		Beginning date for data stored on computer disk
	Q7 (Computer)		Ending date for data stored on computer disk
8	Q8		Format for data stored on computer disk
9	Q9		Computer data can be downloaded to ASCII format
		1	Yes
		2	No
10	Q10		Computer has modem
		1	Yes
		2	No
11	Q11		Lab might be willing to contribute existing data to a state data bank
		1	Yes
		2	No
12	Q12		Manner in which well locations are identified
		1	Address of well location
		2	Address of owner
		3	Both

KEY TO QUESTIONNAIRE RESPONSES (cont'd)

Question	Response	Code	Interpretation
13	Q13		Well location info which lab would be willing to release without a waiver from owner
		1	Street address
		2	Street name only
		3	Approximate longitude and latitude
		4	Town name only
		5	None
14	Q14		Estimated time for employee to provide existing computerized data in form indicated in Q13
		1	15 Minutes
		2	1 Hour
		3	5 Hours
		4	10 Hours
		5	20 Hours
		6	40 Hours
		7	> 40 Hours
15	Q15		Lab would be willing to ask owners to sign a confidentiality waiver form in future
		1	Yes
		2	No
		3	Possibly
16	Q16		Lab would be willing to provide data in future
		1	Yes
		2	No
		3	Possibly
	Q16A		If yes or possibly, best reporting frequency
		1	Monthly
		2	Quarterly
		3	Semiannually
		4	Annually
17	Q17		Estimated employee time to provide future data on regular basis
		1	Practically none
		2	1 Hour per month
		3	1 Hour per week
		4	5 Hours per week
		5	10 Hours per week
		6	> 10 Hours per week
18	Q18		Would lab be willing to supply data only if a compensation rate per hour were arranged
		1	Yes
		2	No

APPENDIX D

Listing of Massachusetts Commercial Environmental Laboratories and Their Test Certifications

Massachusetts Commercial Environmental Laboratories and Their Test Certifications for Parameters for which EPA or DEQE has Assigned Limits

Lab	TM	N	F	P	PCB	H	THM	VOC	CS	Na	Rad	TC*
AGTL Natick	*	*	*	*	-	-	*	-	*	-	-	*
Alpha Analytical Ashland	*	-	*	*	*	-	*	*	*	*	*	-
Aqua Test W. Chatham	-	*	-	-	-	-	-	-	*	*	-	*
Barclay Chemical Co. Watertown	*	*	*	-	-	-	-	-	*	*	-	*
Barnstable County Lab Barnstable	*	*	*	*	-	-	*	*	*	*	-	*
Battelle New England Duxbury	-	-	-	-	-	-	-	-	-	-	-	-
Berkshire Enviro-Labs Lee	-	*	*	-	-	-	-	-	*	*	*	*
Biomarine Research Lab Gloucester	-	*	-	-	-	-	-	-	*	*	-	*
Briggs Associates Rockland	*	*	*	*	-	-	*	*	*	*	-	-
Burgess Analytical Lab North Adams	*	-	-	-	-	-	-	-	*	*	-	-
Cambridge Analytical Boston	*	*	*	*	-	*	*	*	*	*	-	*
Camp, Dresser & McKee Boston	*	*	*	*	*	-	*	*	*	*	-	-
Certified Engineering Weymouth	*	*	*	-	-	-	*	*	*	*	-	*
Chem Test Lab Haverhill	*	-	-	-	-	-	-	-	-	-	-	-
Clean Harbors Analytical Serv. Bedford	*	*	*	*	*	-	*	*	*	*	-	-

Massachusetts Commercial Environmental Laboratories and Their Test Certifications (cont'd)

Lab	TM	N	F	P	PCB	H	THM	VOC	CS	Na	Rad	TC*
Clean Harbors Analytical Braintree	*	*	*	*	*	*	*	*	*	*	*	-
Con-Test Lab E. Longmeadow	*	-	-	*	-	-	*	*	*	*	-	*
Dennison Environmental Woburn	*	-	-	-	*	-	-	-	-	-	-	-
Dirats & Co. Westfield	*	-	-	-	-	-	-	-	-	-	-	-
ERT Wilmington	*	-	-	*	*	-	*	*	-	*	-	-
ESA Bedford	*	*	*	*	-	*	*	-	-	*	-	-
Eastern Analytical Billerica	*	*	*	*	-	*	*	*	*	*	-	-
Energy & Environ. Engineering Somerville	*	-	*	*	-	-	*	-	*	*	-	-
Enseco Cambridge	*	*	*	*	*	-	*	*	*	*	-	-
Environmental Sciences Lab Mansfield	-	-	-	-	-	-	-	-	*	*	-	*
Envirotech Labs Sandwich	-	*	*	-	-	-	-	-	*	*	-	*
GHR Analytical Lakeville	*	*	*	*	*	*	-	-	*	*	-	*
Goldberg - Zoino Labs Newton Upper Falls	-	-	-	-	-	-	-	-	-	-	-	-
Groundwater Analytical Buzzards Bay	-	-	-	-	-	-	*	*	-	-	-	-

Massachusetts Commercial Environmental Laboratories and Their Test Certifications (cont'd)

Lab	TM	N	F	P	PCB	H	THM	VOC	CS	Na	Rad	TC*
Herbert Shuster, Inc. Quincy	-	*	*	-	-	-	-	-	-	*	-	*
Hydrosample Northboro	*	*	*	*	*	-	*	-	*	*	-	-
Ionics Corp. Watertown	*	*	*	-	-	-	-	-	*	*	-	-
J & W Laboratory Millers Falls	-	*	-	-	-	-	-	-	*	*	-	*
Jet-Line Analytical Lowell	-	-	*	-	-	-	*	-	-	-	-	-
LaPuck Labs Watertown	-	*	-	-	-	-	-	-	*	*	-	*
Lenox Inst. for Research Lenox	*	-	*	-	-	-	*	-	*	*	-	*
Lycott Environ. Research Southbridge	*	*	*	*	-	*	*	-	*	*	-	*
Millipore Corp. Bedford	*	*	-	-	-	-	-	-	*	*	-	*
New England Chem Works Dighton	*	*	-	-	-	-	-	-	*	*	-	*
New England Chroma-Chem Co. Salem, MA	*	-	-	-	*	-	*	*	-	-	-	-
Oliveira Environmental Labs Bridgewater	*	*	*	-	-	-	-	-	*	*	-	*
R.T.I. Attleboro	-	-	-	-	-	-	-	-	-	-	-	-
Reitzel Associates Boylston	*	*	*	-	-	-	-	-	*	*	-	*

Massachusetts Commercial Environmental Laboratories and Their Test Certifications (cont'd)

Lab	TM	N	F	P	PCB	H	THM	VOC	CS	Na	Rad	TC*
Revet Environ. & Analytical Worcester	*	-	*	*	-	*	*	*	-	*	-	-
SP Engineering Salem	-	*	-	-	-	-	-	-	*	-	-	-
Skinner & Sherman Labs, Inc. Waltham	*	*	*	*	*	*	*	*	*	*	-	-
Standard Methods Lab Barre	*	*	*	-	-	-	-	-	*	*	-	*
Stevens Water Analysis Stoneham	*	*	*	*	*	-	*	*	-	*	-	*
Thorstensen Labs, Inc. Westford	-	*	*	-	-	-	-	-	-	*	-	*
Tighe & Bond Lab Easthampton	*	*	*	*	-	-	*	*	*	*	-	*
Toxican Corp. Woburn	*	*	*	-	-	-	*	-	*	*	-	*
Wastewater Env. Mgmt., Inc. Acton	-	-	-	-	-	-	-	-	-	-	-	-
Water Control Lab Hopkinton	*	*	*	-	-	-	*	*	-	*	-	*
Waterworks Lab Leominster	*	*	-	-	*	-	*	-	*	*	-	*
Whitman & Howard Lab Wellesley	*	*	*	-	-	-	-	-	*	*	-	*

*TM = Trace Metals, N = Nitrate, F = Fluoride, P = Pesticides, PCB = Arochlors, H = Herbicides, THM = Trihalomethanes, VOC = Volatile Organics, CS = Corrosivity Series, Na = Sodium, Rad = Radioactivity, TC = Total Coliform

APPENDIX E

Listing of Contacts from Potential User Pool

Contacts from Survey of Potential User Pool

Members of Technical Advisory Committee

DEQE Office of Research and Standards
Carol Rowan West (617) 292-5509
Andrea Papadopoulos (617) 556-1052
Karen Martin (617) 556-5841
1 Winter Street
Boston, MA 02108

DEQE Division of Water Supply
David Terry (617) 292-5529
Dorothea Williams (617) 292-5528
1 Winter Street
Boston, MA 02108

Department of Environmental Management
Division of Water Resources
Richard Thibideau (617) 727-3267
100 Cambridge Street
Boston, MA 02202

United States Geologic Survey
Michael Frimpter (617) 565-6877
150 Causeway Street, Suite 1001
Boston, MA 02114-1384

Department of Food and Agriculture
Pesticide Bureau
Lee Corte-Real (617) 727-2863
100 Cambridge Street
Boston, MA 02202

Massachusetts Association of Boards of Health
Marcia Benes (508) 695-1128
56 Taunton Street
Plaineville, MA 02762

DEQE Division of Hazardous Waste
Linda Benevides (617) 292-5782
1 Winter Street
Boston, MA 02108

DEQE Information Center
Jacquie Doherty (617) 292-5701
1 Winter Street
Boston, MA 02108

DEQE Office of Special Projects
George Zoto (617) 292-5966
1 Winter Street
Boston, MA 02108

DEQE Office of Right to Know
Linda Darveau (617) 292-1075
1 Winter Street
Boston, MA 02108

Others Contacted

State Department of Public Health
Robert Knorr (617) 727-7170
Center for Epidemiology and Toxicology
150 Tremont Street, 7th floor
Boston, MA 01222

University of Massachusetts
Water Resources Center
Paul Godfrey (413) 545-2842
Blaisdell House
U. Massachusetts, Amherst, MA 01003

Department of Public Health
Gary Moore (413) 545-0484
Division of Environmental Health
Morrill Hall
U. Massachusetts, Amherst, MA 01003

Dufresne and Henry, Inc., Consulting Engineers
Jack Spanbauer (413) 773-3642
278 Main Street
Greenfield, MA 01301

Pioneer Ecology, Water Purification Systems
Sandy Thomas (413) 773-3486
50 Crescent Street
Greenfield, MA 01301

Department of Environmental Management
Division of Water Resources
Thomas Klock (617) 727-3267
100 Cambridge Street
Boston, MA 02202